

**BULL TROUT LIFE HISTORY INVESTIGATIONS IN THE
NORTH FORK CLEARWATER RIVER BASIN**

**REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS
NORTH FORK CLEARWATER RIVER BULL TROUT**

**Annual Report
2002**

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ABSTRACT

In 2002, a total of 274 bull trout were captured in Dworshak Reservoir. Seventeen of these were recaptures; 7 from 2001 and 10 previously tagged in 2002. These fish ranged in total length from 185 – 667 mm and weight ranged from 50 – 2550 g. Of these 107 were radio-tagged. Migration from the reservoir began on 1 June 2002. Eight-nine percent of the migratory radio-tagged bull trout were located in riverine habitat by 21 June 2002. Sixty-eight percent (13/19) of the radio-tagged bull trout that survived spawning in 2001 and returned to the reservoir were documented returning to spawning areas in 2002. Of the thirteen fish that returned to spawning areas in 2002, 46% (6/13) did not return to the same spawning area as in 2001. It is uncertain if these fish spawned in both years but if they did there is a great deal of straying in this population. We documented spawning occurring in four previously unknown spawning areas. the population of adult migratory bull trout is estimated at 1476.6 adults in specific areas known to contain spawning aggregates in the North Fork Clearwater River basin. This translates to an estimated 18.25 migratory adult per linear river kilometer in these areas.

INTRODUCTION

In 1971 the construction of Dworshak Dam was completed near the mouth of the North Fork Clearwater River (NFCR). The 218 m tall dam inundated greater than 100 km of riverine habitat on the mainstem of the North Fork Clearwater River and its tributaries. In the absence of any fish passage facilities anadromous fish runs have been eliminated from the NFCR above Dworshak Dam. Impacts on resident fish species in the basin are not as clear.

The construction of Dworshak Dam may have significantly reduced the distribution, abundance, and population viability of native resident fish populations in Dworshak Reservoir and its upstream tributaries (Columbia River Basin Fish and Wildlife Authority 1997). However, information that is needed to support this assumption is limited.

Historical observations document bull trout *Salvelinus confluentus* throughout the NFCR basin. Bull trout were found in the basin prior to construction of Dworshak Dam (Cannon 1970) and are still found in the NFCR, many of its tributaries and Dworshak Reservoir (Lindland 1987, Statler 1988, Schriever and Cochnauer 1996, Weigel and Cross 1997; Weigel and Zakrajsek 1998). However, measuring changes in bull trout population abundance and distribution in the basin is difficult because of the lack of pre- and post-dam data. There is also a lack of information on bull trout populations in basins without dam and reservoir influences to use as comparable controls. As a result, direct assessment of the change in bull trout population dynamics due to the construction of Dworshak Dam is likely not feasible. However, assessment of the status, structure, and viability of the current bull trout population remaining in the NFCR basin is possible. Determining whether their viability and movements are affected by operations of Dworshak Dam and its physical attributes can also be determined. The investigation of these issues will help provide the information necessary to assess the need for, and determination of strategies to protect and perpetuate viable populations of bull trout in the NFCR basin.

Although bull trout have been observed and collected throughout the basin prior to this study, little quantitative information is available on their life history, distribution, and abundance. More importantly, other than documenting presence or absence, no information prior to these findings defines the role Dworshak Reservoir plays in the life history, distribution and abundance of bull trout in the drainage.

Bull trout populations are susceptible to habitat disruption and fragmentation (Rieman and McIntyre 1993). Dworshak Dam has possibly isolated bull trout population(s) in the NFCR from genetic exchange with other populations in the Clearwater basin and caused fragmentation of remaining NFCR populations. The impact(s) of severing the connectivity between the NFCR bull trout populations and other Clearwater River populations may be crucial in sustaining a viable bull trout population upstream of Dworshak Dam. Without more information, the disruption of this migratory corridor can be viewed as a threat to the persistence of bull trout populations in the North Fork Clearwater River.

This study was designed to document and describe bull trout temporal and spatial distribution and life history within the NFCR drainage. This information will be used to develop and implement strategies to protect and perpetuate bull trout populations in the NFCR drainage with regards to operation of Dworshak Dam and project area.

STUDY SITE

The NFCR is a fourth order stream located in north central Idaho (Figure 1). It has a total drainage area of 739,982 ha with the headwaters extending into the Bitterroot Mountains and forming the western border of Montana. The majority of the drainage is under public ownership by the U.S. Forest Service, Clearwater National Forest. The major tributaries of the NFCR are Little North Fork Clearwater River (LNF), Kelly, Cayuse, Skull, Quartz, Orogrande, and Weitas creeks (Figure 1).

At full pool Dworshak Reservoir is 86.2 km long and has 295 km of steep shoreline. It has a total volume of $4.28 \times 10^9 \text{ m}^3$ that corresponds to a maximum depth of 194 m, mean depth at full pool of 56 m, and a surface area of 6,644 ha (Maiolie and Elam 1994). The main arms of the reservoir are Elk Creek, the LNF, and the NFCR (Figure 1).

Native resident salmonids found within the drainage include bull trout, westslope cutthroat trout *Oncorhynchus clarki lewisi*, rainbow trout *O. mykiss* and mountain whitefish *Prosopium williamsoni*. Anadromous fish have been eliminated from the NFCR drainage since the construction of Dworshak Dam. Prior to that time, chinook salmon *O. tshawytscha* and steelhead *O. mykiss* were found throughout the drainage. Dworshak Reservoir has been stocked with kokanee *O. nerka*, rainbow trout, brook trout *S. fontinalis*, westslope cutthroat trout, bull trout, smallmouth bass *Micropterus dolomieu*, and largemouth bass *M. salmoides*.

OBJECTIVES

1. Obtain basic biological and life history information on bull trout in Dworshak Reservoir and the NFCR drainage.
2. Determine migration patterns of bull trout within the NFCR.
3. Determine spatial and temporal distribution of bull trout within Dworshak Reservoir and the NFCR drainage.
4. Identify bull trout spawning sites within the NFCR.
5. Determine the number of adult bull trout annually migrating from Dworshak Reservoir.

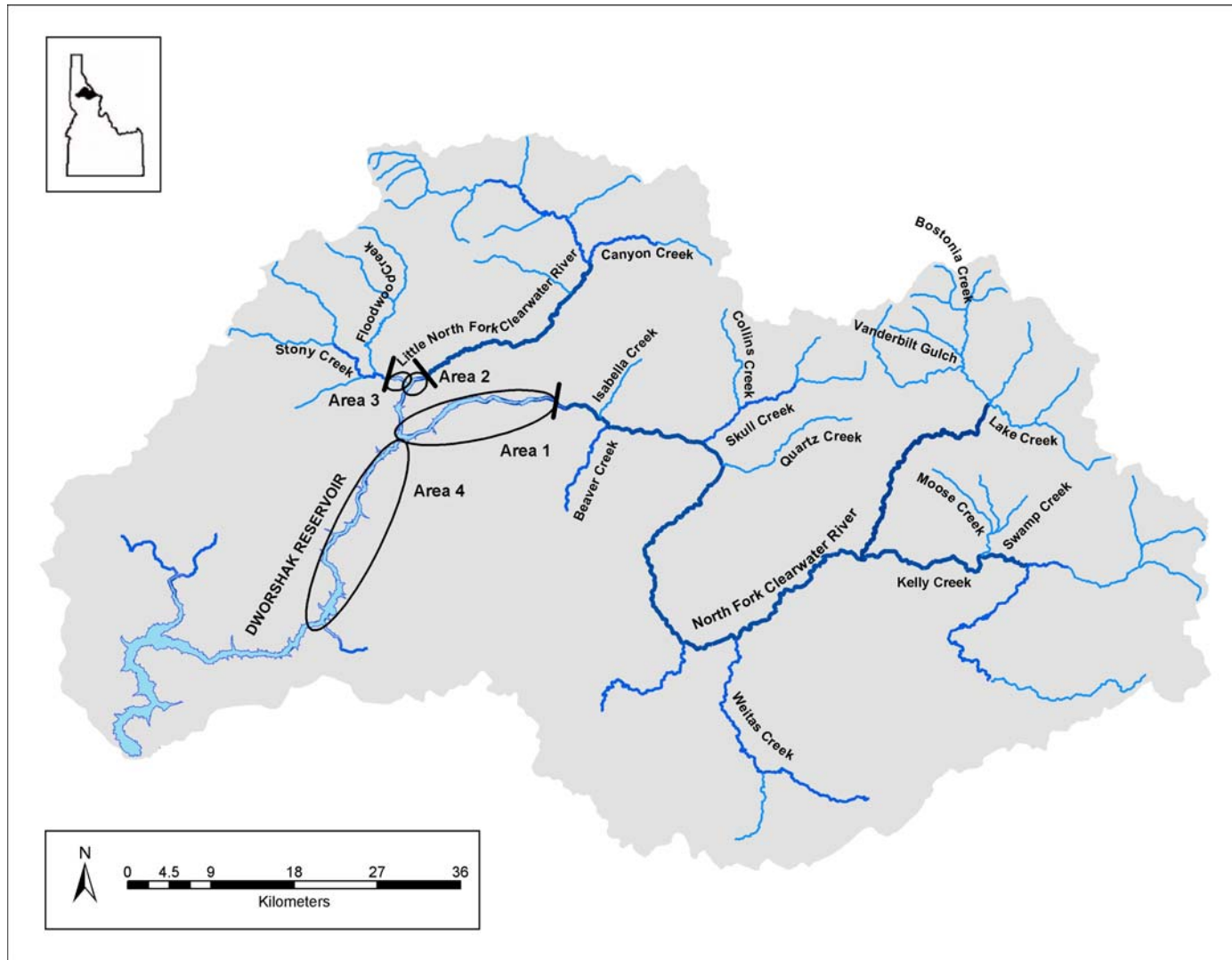


Figure 1. Study area, North Fork Clearwater River drainage. Locations of bull trout capture are the circled regions.

METHODS

Tagging

Bull trout were captured with hook-and-line in the NFCR and LNF arms of Dworshak Reservoir near the slack water/flowing water interface, where bull trout concentrate in early spring. Sampling was conducted in the NFCR arm between rkm 74.1 and rkm 85.8 (area 1), in the LNF arm 5.5-8.0 km above the confluence of the LNF and NFCR (area 2), at the slackwater interface in Breakfast Creek, approximately a 3 km area (area 3), (Figure 1). Bull trout were also collected in Dworshak Reservoir between Elk Creek (rkm 20.1) and Grandad Bridge (rkm 64.4) (area 4) using gillnets, a boat electrofisher and hook-and-line techniques (Figure 1). Sampling was conducted in areas 2 and 3 on 17, 18 and 23 October 2001 to tag post-spawn bull trout returning to the reservoir and increase the number of radio-tagged bull trout in the reservoir during the winter.

Individual bull trout were anesthetized in a 60-80 mg/l solution of MS222. Fish were initially weighed and measured. All fish were scanned for Passive Integrated Transponder (PIT) tags. If a fish was not previously PIT tagged a 134 kHz PIT tag was inserted in the opercula muscle using a 14-gage hypodermic needle. A fin clip was removed for genetic sampling. If the fish was previously PIT tagged the number was recorded. Scales were collected from all bull trout to determine age and verify a recaptured fish's age.

We utilized three types of radio tags, NTC-6-2 (NANO), MCFT-3EM (MICRO) and CAFT11-4 (Lotek Engineering). NANO-tags are radio transmitters that are relatively small in size, weighing 3.8 g. Use of NANO-transmitters allowed us to tag bull trout weighing a minimum of 190 g and maintain a maximum 2% tag to body weight ratio. Currently this is the only transmitter available that is this small and a still provides nearly a year of tag life (318 d). MICRO-transmitters are larger radio transmitters weighing 8.9 g. Larger tag size allows for longer transmitter life compared to the NANO-transmitter. The limitation of all radio transmitters is detection is limited to a depth of 10 m or less because suspended particles in the water scatter the radio transmission. Bull trout likely occupy cooler water in the hypolimnion of Dworshak Reservoir during summer stratification and overwintering. Habitation at these depths prohibits detection of radio transmitters.

CAFT-transmitters are acoustic transmitters. The acoustic transmitter allows for detection in water depths greater than 10 m. We used these tags to monitor bull trout throughout the reservoir during the year. The limitation of the CAFT-transmitters is its inability to be tracked from a fixed-wing airplane, because it is an acoustic transmitter it does not send out a radio signal that can be detected from the air. To increase the probability that CAFT-tagged bull trout would remain within the reservoir, we implanted CAFT-transmitters into bull trout caught in the October only. We assumed bull trout caught at this time period were returning to the reservoir to overwinter.

Tracking and Distribution

Boat and fixed-wing aircraft were utilized to biweekly monitor fish in Dworshak Reservoir. Additional tracking in riverine sections of the study area was completed using automobiles, fixed-wing aircraft and hiking. In addition to mobile tracking we established three stationary radio-receiving sites. The NCFR fixed site was located at rkm 96.6, approximately 4.8 km upstream of Dworshak Reservoir (at full pool). The LNF fixed site was located 10.0 km from the confluence of the LNF and NCFR. The Breakfast Creek (BFC) fixed site was located at the confluence of Breakfast and Floodwood creeks. These sites were approximately 1.0 km and 1.1 km upstream of Dworshak Reservoir (at full pool), respectively. We classified bull trout as leaving or entering the reservoir when first recorded on either the NCFR, LNF or BFC receivers on its upstream or downstream migration.

Distribution of radio-tagged fish was grouped into three time periods based on bull trout life history patterns and the different habitats that are used during these time periods. The three time periods are: migration, May through July; spawning, August through 15 October; and overwinter, November through April.

We wanted to determine possible localized spawning populations. The best geographical representation of this we could easily determine and use was the 5th field Hydrologic Unit Code (HUC) described by the USGS (1982). Radio-tagged bull trout were delineated into these HUCS based on their furthest documented upstream location or their location at the time of spawning.

Population Estimate

Adult bull trout population estimates were conducted when the fish were in pre-spawning aggregates in riverine habitat. Population estimates were conducted using a random sampling design that incorporates radio tracking and snorkeling techniques. A section of stream was flown to identify the location of radio-tagged bull trout. The GPS coordinates were recorded when a radio transmitter was detected. A field crew would then locate the GPS coordinates on the ground within 1 to 6 days after the flight. Through triangulation methods, the transmitter's position would be pinpointed to within a 10 m section of stream. We established a primary 100 m transect that included the 10 m section of stream containing the radio transmitter(s). This primary transect would be snorkeled, beginning and ending at natural habitat breaks. Snorkel surveys were completed using one to six people depending on the width and visibility of the stream at the transect location. Snorkelers would enter the river downstream of the transect, form a straight line, perpendicular to the flow and proceed upstream to the top of the transect. Snorkelers identified all fish observed. Species and total lengths to the nearest inch were recorded. When a bull trout was observed it was recorded as radio-tagged, adipose clipped or neither. Special notation was used when a bull trout was identified but length and fins were not. When a radio-tagged bull trout was not observed in the transect, the area was searched further to determine if the transmitter was still in a live fish that was missed by snorkelers, or if the signal was from a transmitter only. When the transmitter was found no longer in a fish the transect data was not included in the ratio estimate calculation.

A secondary, randomly chosen transect, was snorkeled in addition to each primary transect. The secondary transects were sampled to determine if we were biasing our sample by selecting locations known to have radio-tagged fish in them. A random number between one and ten was generated using Excel's random number generating program. When the numbers one through five were selected it corresponded to snorkeling a transect adjacent to and up to five hundred meters downstream from the primary transect. Numbers six through ten selected a transect the same way except these transects were upstream of the primary transect. The secondary transect was snorkeled and fish recorded in the same manner as the primary transect, but it was not searched for radio-tagged fish before being snorkeled.

To determine the number of adult bull trout (those > 350 mm) that migrated from Dworshak Reservoir, a population estimate was generated using a ratio estimate and extrapolating to an estimated number of bull trout per kilometer in discreet stream reaches. The ratio estimate is the total number of radio-tagged bull trout observed in all primary transects divided by the number of radio-tagged bull trout that were known to be in these transects. This allows us to estimate the percent of bull trout we were observing while snorkeling. This ratio was then applied to all transects snorkeled, primary and secondary, to estimate the number of bull trout in the sampled area. To calculate an adult population estimate for those areas where pre-spawn bull trout are known to congregate, the estimate of bull trout in the area surveyed was converted into bull trout per kilometer. This required taking the estimated number of bull trout observed and dividing by the total length of stream surveyed. The estimated number of bull trout per kilometer was applied to the stream reaches where we had known pre spawning aggregates of bull trout. The length of these stream reaches was estimated using MAPTECH Terrain Navigator 2002.

Redd Surveys

Redd surveys were conducted from the last week of August until the end of September. Surveyed tributaries were selected based on the occurrence of radio-tagged bull trout either in the tributary or in the mainstem near a tributary mouth. Observers walked stream reaches and identified redds and recorded their physical attributes and their GPS coordinates. Occurrence of bull trout on the redd or in the stream was also recorded.

RESULTS

Tagging

We captured 209 bull trout from 17 April to 1 July 2002 in Dworshak Reservoir (Table 1, Appendix A). An additional 65 bull trout were collected 4 -22 October 2002 (Appendix A). Seventeen bull trout were recaptured, of which seven were previously radio-tagged (Table 1). Twelve of the recaptures were fish initially captured and tagged in 2001, and the remaining four were recaptures from earlier in 2002 (Table 1). Total length of all captured bull trout, including all recaptures, in 2002 ranged from 185 mm to 667 mm, mean 383.8 mm (Figure 2, Table 2) and weight ranged from 50 to 2,550 g, mean 599.0 g (Figure 3, Table 2). Radio transmitters were implanted in 114 bull trout, 77 in the spring, and 37 in the fall (Table 1). Ten bull trout radio-tagged in the spring were not recorded on a fixed receiver or detected during flight tracking at any time from May to October.

Eighty-two percent (224/274) of the bull trout were captured in the slack water interfaces in the NFCR and LNF arms of Dworshak Reservoir; of the remaining 18%, seven were captured at large in the reservoir and sixteen were captured in the mainstem NFCR in the fall. Sixty-four bull trout were implanted with MICRO-transmitters, three with NANO- transmitters, and 37 with CAFT-transmitters (Table 1).

Table 1. Total number of bull trout captured, recaptured and implanted with radio transmitters in 2002 by tagging group and transmitter type. The recaptures under 2001 are fish initially captured in 2001 and recaptured in 2002. Recaptures under 2002 are bull trout initially captured in 2002 and recaptured in 2002.

TAGGING GROUP	TOTAL Captured 2002	Recaptures		Transmitter Type			TOTAL Radio-tagged	Subbasin Located in After Migration			
		2001	2002	NANO Spring	MICRO Spring	CAFT Fall		NFCR	LNF	BFC	DWORSHAK
Area 1: NFCR	113	5	1		32	13	45	26			4
Area 2: LNF	95	5	3		27	19	46	3	17	1	
Area 3: BFC	32	1			9	5	14	2	4	1	2
Area 4: DWORSHAK	34	2		3	6		9		2	1	4
TOTAL	274	12	4	3	74	37	114	31	23	3	10

Table 2. Summary statistics of total length and weight for all bull trout captured in the North Fork Clearwater River drainage in 2002.

	Total Length (mm)	Weight (g)
Mean	383.8	599.0
Median	381.5	470
Standard Deviation	85.20	462.71
Sample Variance	7258.21	214100.17
Minimum	185	50
Maximum	667	2550
Sample Size	274	274

Migration

We first detected a radio-tagged bull trout migrating from the reservoir on 1 June 2002, at the LNF receiver (Table 3). By 21 July 2002, 89% of all bull trout that would migrate out of the reservoir had moved above the fixed sites and were in riverine habitat (Figure 4). The peak of migration occurred during the week 17 - 23 June 2002 (Figure 4). The last individual to leave the reservoir moved above the LNF fixed site on 12 August 2002. All individuals that moved upstream to riverine habitat and were monitored throughout the summer reached their furthest upstream location by 19 September 2002 (Table 3).

The first downstream migrating bull trout, possibly post-spawner, to pass a fixed site station was documented on 7 September 2002 at the NFCR receiver (Figure 4, Table 3). The peak of downstream migration occurred during the week 7 - 13 October 2002 (Figure 4). Twenty-five bull trout were detected returning to the reservoir before the fixed sites were removed the first week of November 2002 (Figure 4, Table 3). Subsequent tracking has detected an additional 50 bull trout returning to the reservoir, however their exact date of return is unknown.

In the spring 32 bull trout were tagged in area 1, of these 30 were detected after initial tag implantation. Of these, 26 (87%) migrated above the fixed site on the NFCR, and four (13%) moved further down into the reservoir where they remained throughout the summer (Table 1).

In the spring 27 bull trout were radio-tagged in area 2, of these 21 were detected after initial tag implantation. Of these, seventeen (81%) migrated upstream of the LNF fixed site, three fish migrated from this tagging area and migrated into the NFCR drainage, and one migrated into the Breakfast-Floodwood Creek drainage (Table 1). The majority of bull trout tagged in the NFCR and LNF (areas 1 and 2) tagging areas migrated upstream into the tributary associated with the tagging area.

Nine bull trout were radio-tagged in area 3; all were detected after initial tag implantation. One (11%) migrated into the BFC drainage, four (44%) migrated into the LNF drainage, two (22%) moved into Dworshak Reservoir where they remained throughout the summer, and two (22%) migrated into the NFCR (Table 1). This is the only tagging area where more fish migrate to alternative locations than ascended the associated tributary.

Nine bull trout were radio-tagged in area 4, of these 7 were detected after initial tag implantation. Of these, four (57%) remained within the reservoir throughout the summer; three (43%) migrated into tributaries, one (14%) into the BFC drainage and two (29%) into the LNF drainage (Table 1). An additional 37 bull trout were radio-tagged with acoustic transmitters in October in areas 1, 2 and 3, plus in the mainstem NFCR from rkm 91.9 through rkm 166.5. As of the date of this report their migration has not been documented. All radio-tagged fish will continue to be monitored throughout the winter months in the reservoir and river environments.

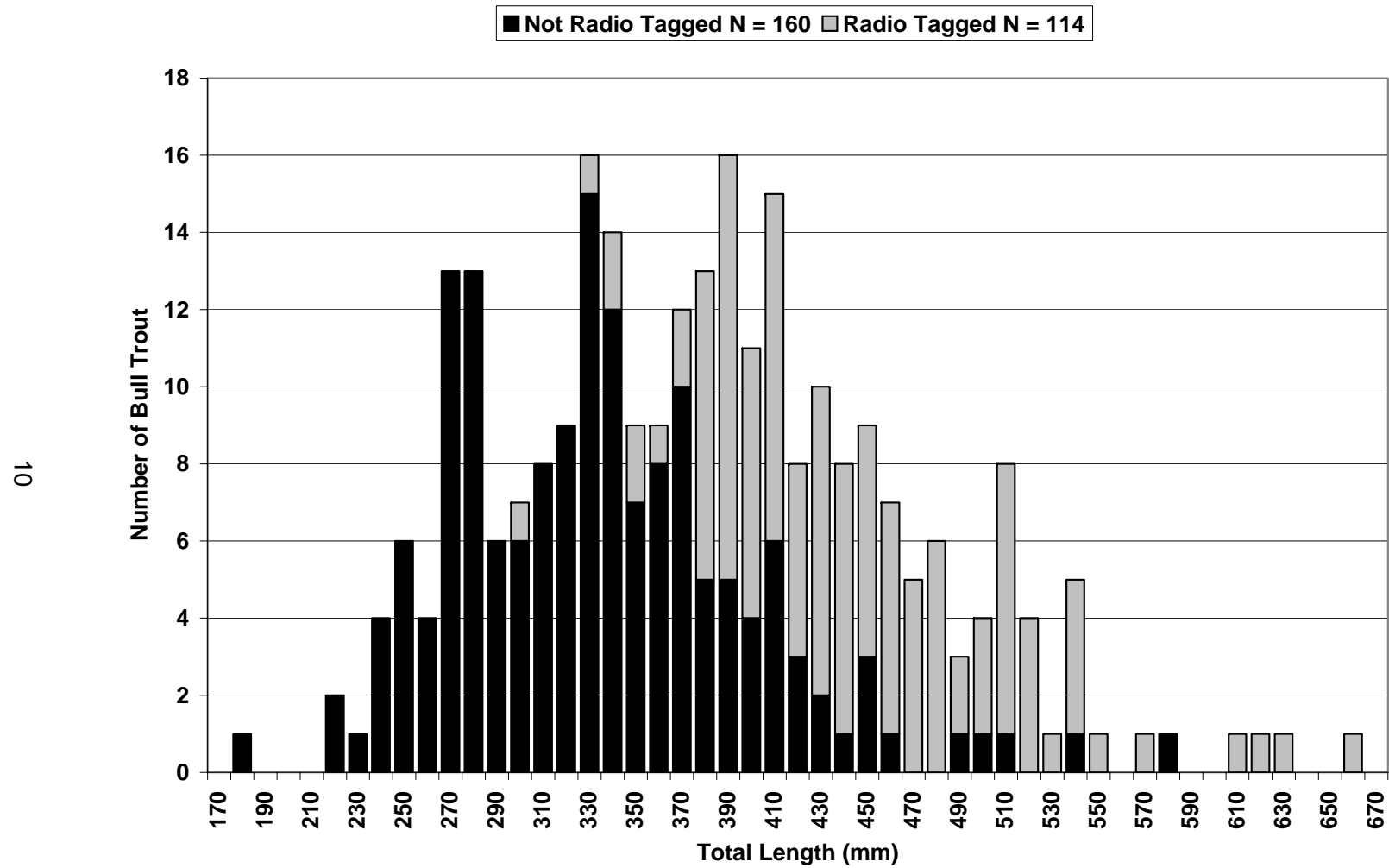


Figure 2. Total length distribution for all bull trout captured in the North Fork Clearwater River drainage, 2002.

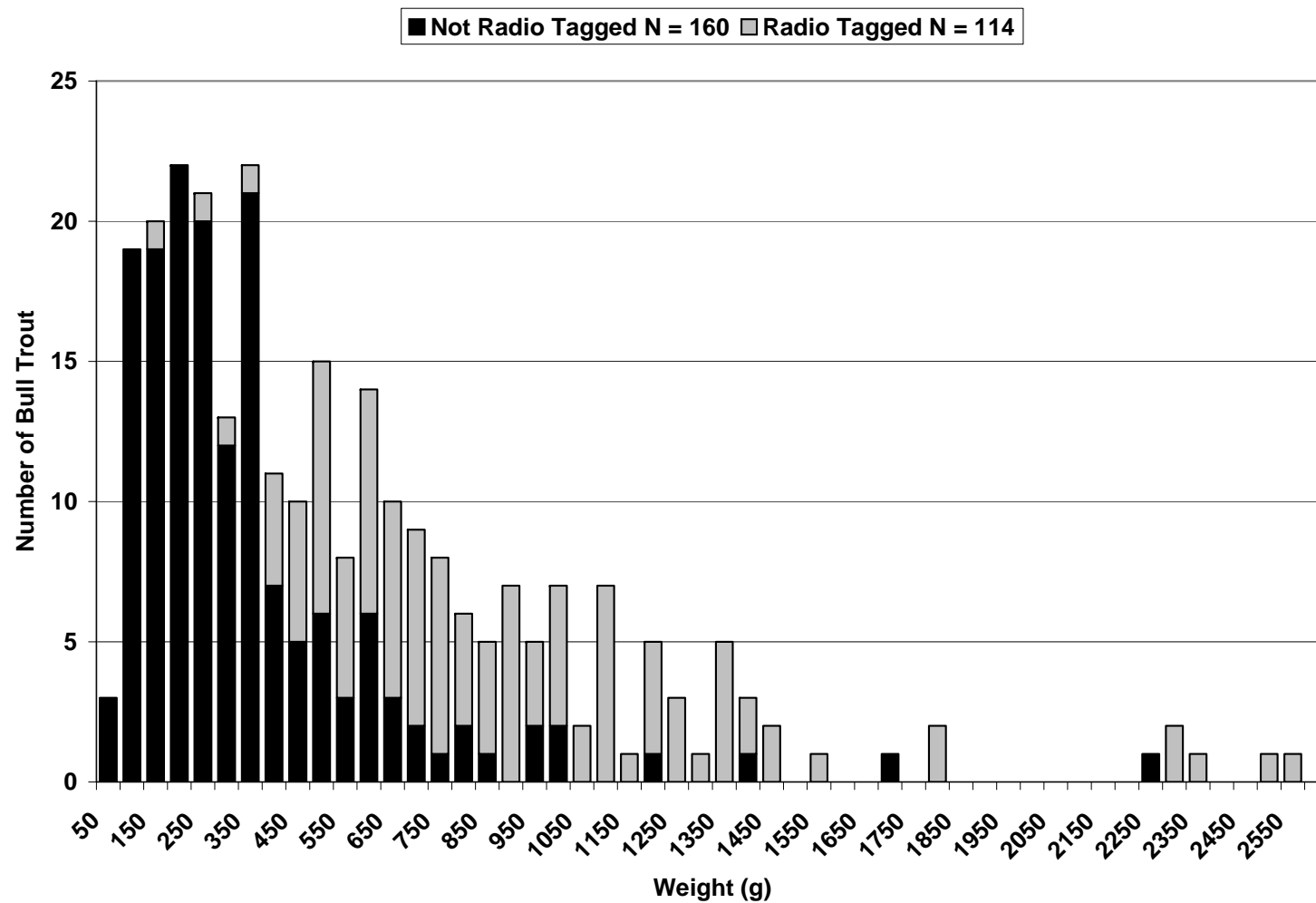


Figure 3. Weight distribution for all bull trout captured in the North Fork Clearwater River Drainage, 2002.

Table 3. Watershed group, migration timing and total migration distance of bull trout radio-tagged in 2001 and tracked in 2002.

Bull Trout Radio Number (Frequency -Code)	Tagging Subgroup	Watershed Group 2001	Date past fixed site upstream	Date located at maximum migration point ²	Date past fixed site downstream	Migration distance from tagging location (km) ¹ 2001	Downstream migration distance (km) 2001-2002	Watershed Group 2002	Date past fixed site upstream 2002	Date located at maximum migration point ²	Total Migration Distance in 2002	Date past fixed site downstream 2002	Alternate or Repeat Year Spawner	Total Migration Distance 2001-2002
148.48.015	BFC	Stony Creek	22-Jun-01	31-Jul-01	9-Oct-01	7.1	6.8	Upper LNF	17-Jul-02	6-Aug-02	36.6	7-Oct-02	Repeat	50.6
148.48.025	BFC	Stony Creek	21-Jun-01	11-Jul-01		13.5	69.0	Middle LNF		27-Jun-02	58.6		Alternate	141.1
148.77.003	BFC	Stony Creek	10-Jun-01	11-Jul-01	4-Oct-01	8.8	10.1	Middle LNF		30-May-02			Unknown	18.9
148.48.008	LNF	Upper LNF	4-Jun-01	15-Aug-01	4-Oct-01	43	53.4	Upper LNF	21-Jul-02	3-Sep-02	50.8	27-Oct-02	Repeat	147.2
148.48.009	LNF	Upper LNF	31-May-01	11-Jul-01	29-Sep-01	51.2	53.7	Upper LNF		3-Sep-02	48.7	29-Sep-02	Repeat	153.6
148.77.004	LNF	Upper LNF		31-Jul-01	3-Oct-01	57.7	96.1	Upper LNF	22-Jun-02	3-Sep-02	157.3		Repeat	311.1
148.77.008	LNF	Upper LNF	7-Jun-01	15-Aug-01		43	83.6	Upper LNF	16-Jun-02	9-Aug-02	44.1		Repeat	170.7
148.77.010	LNF	Upper LNF		31-Jul-01	4-Oct-01	42.4	68.4	Upper LNF	22-Jun-02	6-Aug-02	69.6		Repeat	180.3
150.10.008	LNF	Upper LNF	18-Jun-01	15-Aug-01		33.2	42.2	Long Creek		19-Aug-02	147.3	10-Oct-02	Repeat	222.7
148.77.007 ^B	LNF						23.5	Upper LNF	24-Jun-02	19-Sep-02	86.1		Unknown	109.6
148.77.013	LNF							Upper LNF		19-Aug-02	49.3		Unknown	49.3
149.44.066	LNF							Middle LNF		6-Aug-02	34.8		Unknown	34.8
149.44.068	LNF							NFCR		6-Aug-02	38.9		Unknown	38.9
149.44.070	LNF						10.6	Middle LNF		19-Aug-02	19.0		Unknown	29.7
149.44.071	LNF							Upper LNF		19-Aug-02	63.1		Unknown	63.1
148.48.012	NFCR	Canyon Creek	17-Jun-01	15-Aug-01		60.4	82.2	Floodwood Creek		19-Sep-02	58.9		Repeat	201.5
148.48.020	NFCR	Headwaters NFC	9-Jul-01	14-Aug-01		117.3	171.1	Headwaters NFCR		6-Aug-02	152.9		Repeat	441.3
148.48.004	NFCR	Long Creek	9-Jul-01	30-Jul-01		116.1	165.3	Osier Creek		3-Sep-02	156.7	20-Oct-02	Repeat	438.1
148.48.007	NFCR	Long Creek	9-Jul-01	8-Aug-01		89.8	108.3	Osier Creek		4-Oct-02	107.1		Repeat	305.2
148.48.013	NFCR	NFCR		10-Jul-01	*	8.1	0.0	Upper LNF	19-Jun-02	6-Aug-02	57.1	21-Oct-01	Alternate	65.2
148.48.014	NFCR	NFCR		10-Jul-01	**	6.9	53.6	Long Creek	11-Jul-02	6-Aug-02	139.8		Alternate	200.3
148.91.025	NFCR	NFCR		13-Jun-01	**	-1.1	9.0	NFCR		8-May-02			Unknown	7.9
148.48.002	NFCR	Quartz Creek	9-Jul-01	30-Jul-01	15-Sep-01	28.6	54.5	Quartz Creek	7-Aug-02	3-Sep-02	55.4	6-Sep-02	Repeat	138.5
148.93.036	NFCR	Quartz Creek		14-Aug-01		9.4	105.8	Long Creek		19-Aug-02	184.8		Repeat	300.1
148.48.019	NFCR							Floodwood Creek		3-Sep-02	17.4		Unknown	17.4
148.48.017 ^B		Mid-LNF		20-Oct-01	6-Oct-01	8.8	41.5	Upper LNF	20-Jul-02	19-Sep-02	62.9		Unknown	113.2

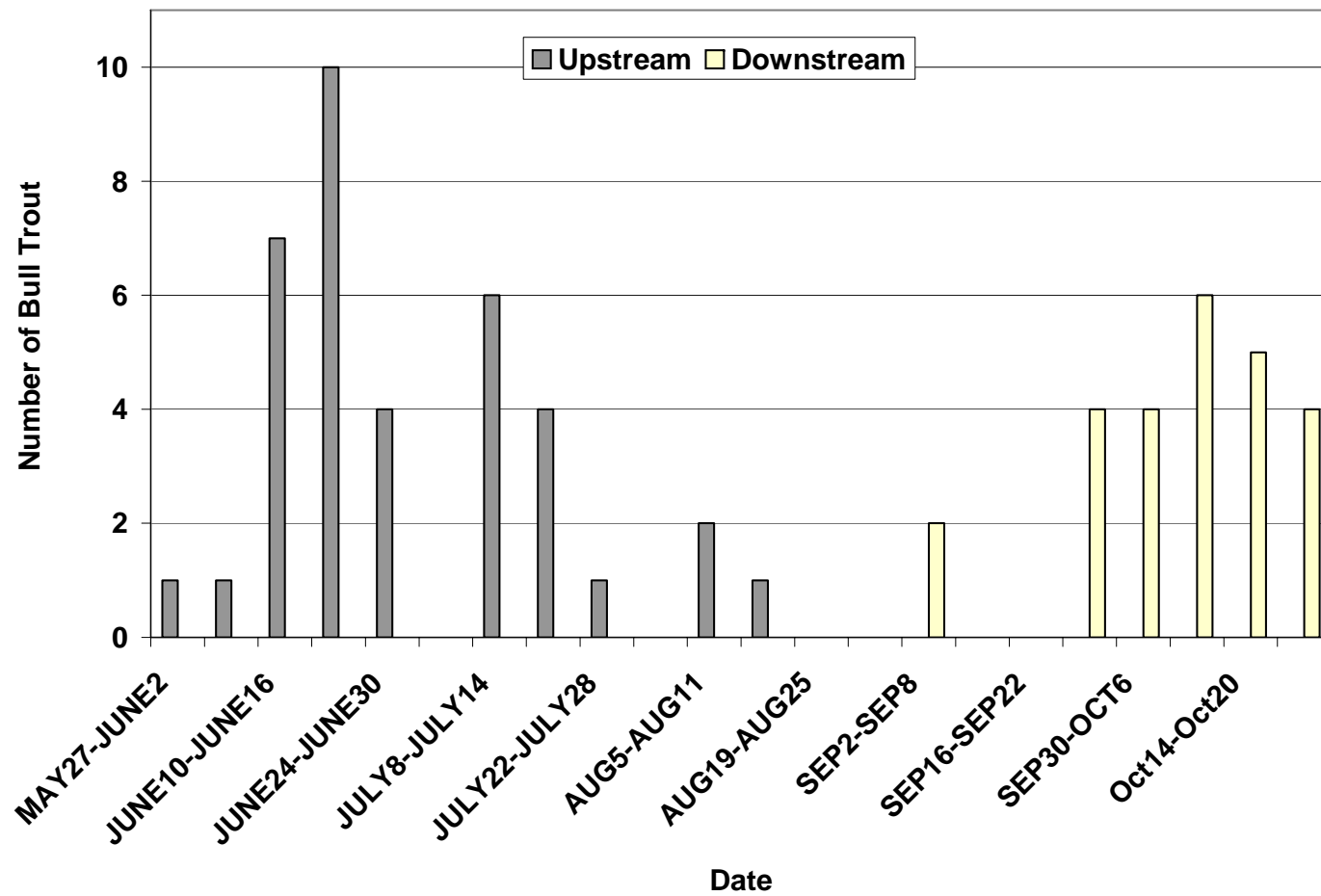


Figure 4. Bull trout migration timing past a fixed site as determined by radio telemetry. Fixed sites were installed on 15 May 2002 and removed on 5 November 2002.

Distribution

Distribution of radio-tagged fish was grouped into three time periods: migration, May through July; spawning, August through 15 October; and overwinter, November through April. During the migration time period 88% (362/411) of the radio transmitter detections were distributed in Dworshak Reservoir above Grandad Bridge and throughout the mainstem NFCR and LNF. The remaining 7.5% (31/411) were detected in Dworshak Reservoir below Grandad Bridge and 4.4% (18/411) were detected in tributaries to the NFCR or LNF (Figure 5).

During the spawning period, 65% (240/369) of the radio transmitter detections were located in the mainstem LNF or NFCR. Thirty-two percent (77/240) of these were located in the LNF mainstem from the mouth of Canyon Creek to the headwaters, 20% (49/240) were located from Black Canyon to the mouth of Lake Creek, and the remaining 48% (114/240) were located in the lower mainstem LNF and NFCR (Figure 6). The remaining 22% (83/369) and 12% (46/369) were located in tributaries to the NFCR and LNF and Dworshak Reservoir, respectively (Figure 6).

During the overwintering period, extending from November 2000 to April 2001, eight radio transmissions were detected; five in the mainstem NFCR, one in the NFCR arm of Dworshak Reservoir, and two in Dworshak Reservoir below Grandad Bridge (Figure 7). From November 2001 to April 2002, 30 radio transmissions were detected; two in the mainstem NFCR, two in the NFCR arm of Dworshak Reservoir, five in the LNF arm of Dworshak Reservoir, and 21 in Dworshak Reservoir below Grandad Bridge (Figure 7). In 2001-2002, the majority of overwinter detections in Dworshak Reservoir occur between rkm 30.1 and rkm 49.9.

Radio-tagged bull trout were distributed in fifteen watershed groups throughout the study area (Table 4). The watershed groups within the NFCR Subbasin were, Headwaters NFCR, Cold Springs, Collins, Kelly, Long, Lost Pete, Osier, and Quartz creeks (Table 4, Figure 8). Bull trout within Cold Springs, Kelly and Lost Pete watershed groups remained in the mainstem NFCR or Kelly Creek and were never detected in a tributary (Table 4, Figure 8). These fish may have entered a tributary for less than fourteen days but were undetected by our biweekly flight schedule. Bull trout that entered tributaries were in the following watershed groups: Headwaters NFCR, Collins, Osier, and Quartz creeks. The Long Creek watershed group consisted of twelve radio-tagged bull trout, ten remained in the Black Canyon section of mainstem NFCR and two immigrated into Lake and Long creeks. Radio-tagged bull trout from this watershed group may have immigrated into tributaries for a short duration but were undetected during our biweekly flight schedule.

The watershed groups within the LNF Subbasin were: Middle and Upper LNF and Floodwood and Stony creeks (Table 4). The Floodwood Creek watershed group consisted of a single radio-tagged bull trout and the Stony Creek watershed group consisted of two radio-tagged bull trout (Table 4). The Middle LNF watershed group consisted of eight radio-tagged bull trout that were detected in the mainstem only (Table 4, Figure 8). Fifteen bull trout immigrated into the Upper LNF; this represented the highest concentration of radio-tagged bull trout to be located within a watershed group (Table 4, Figure 8).

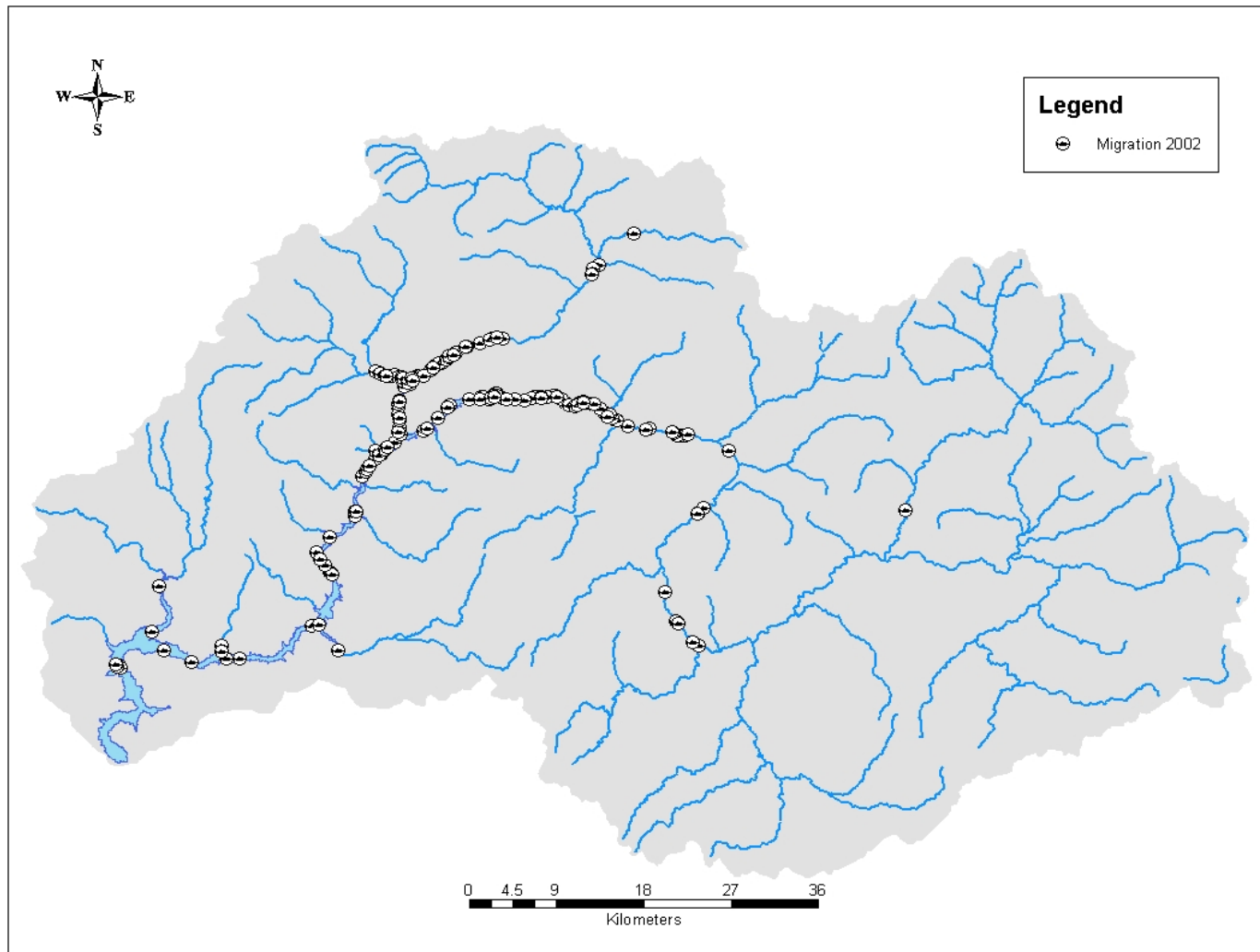


Figure 5. Distribution of all radio-tagged bull trout detections during the migration time period, 01 May 2002 through 30 July 2002, in the North Fork Clearwater River.

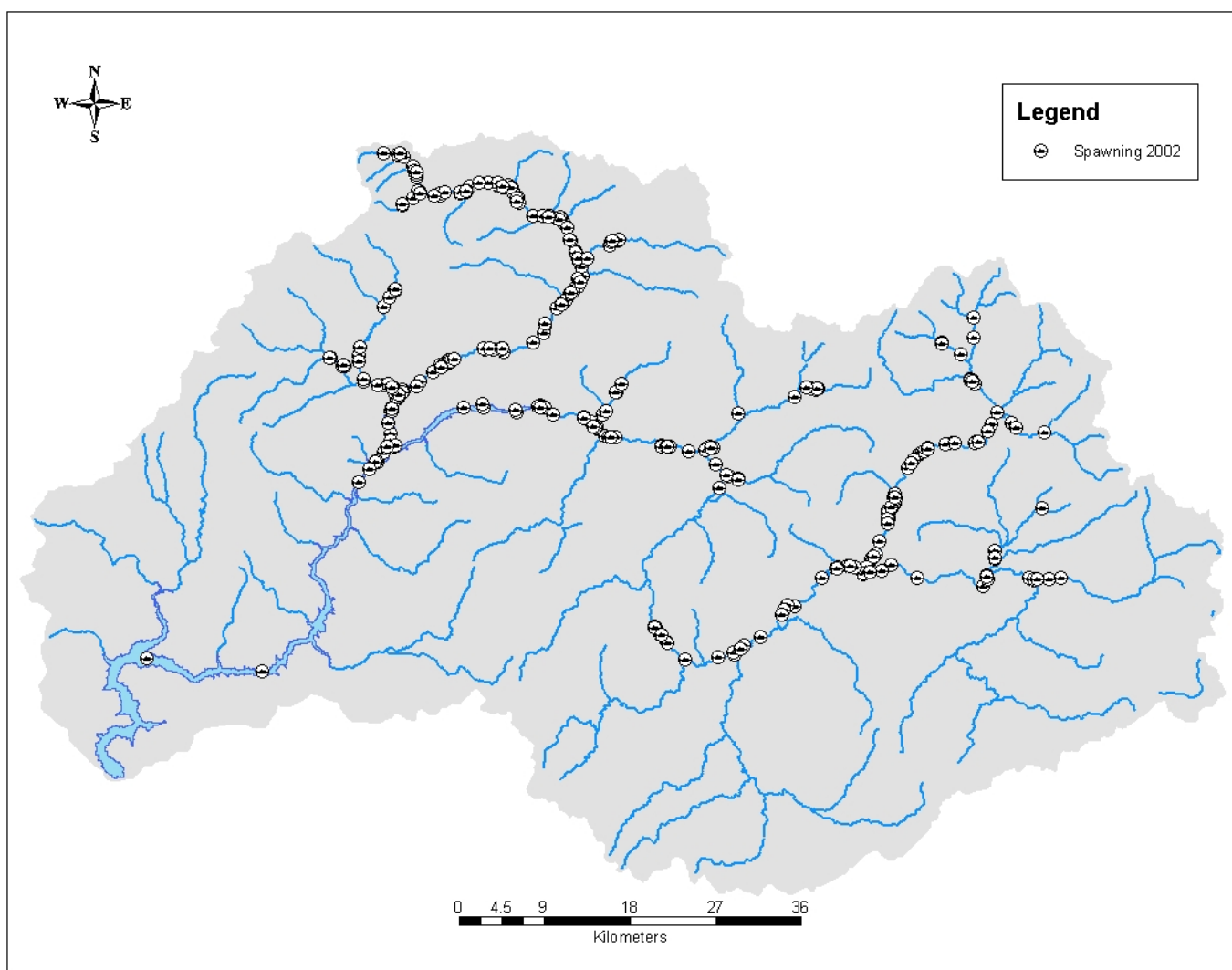


Figure 6. Distribution of all radio-tagged bull trout detected during the spawning time period, 08 August 2002 through 15 October 2002, in the North Fork Clearwater River. Each radio-tagged bull trout is represented only once during this time period for simplification of distribution and numbers.

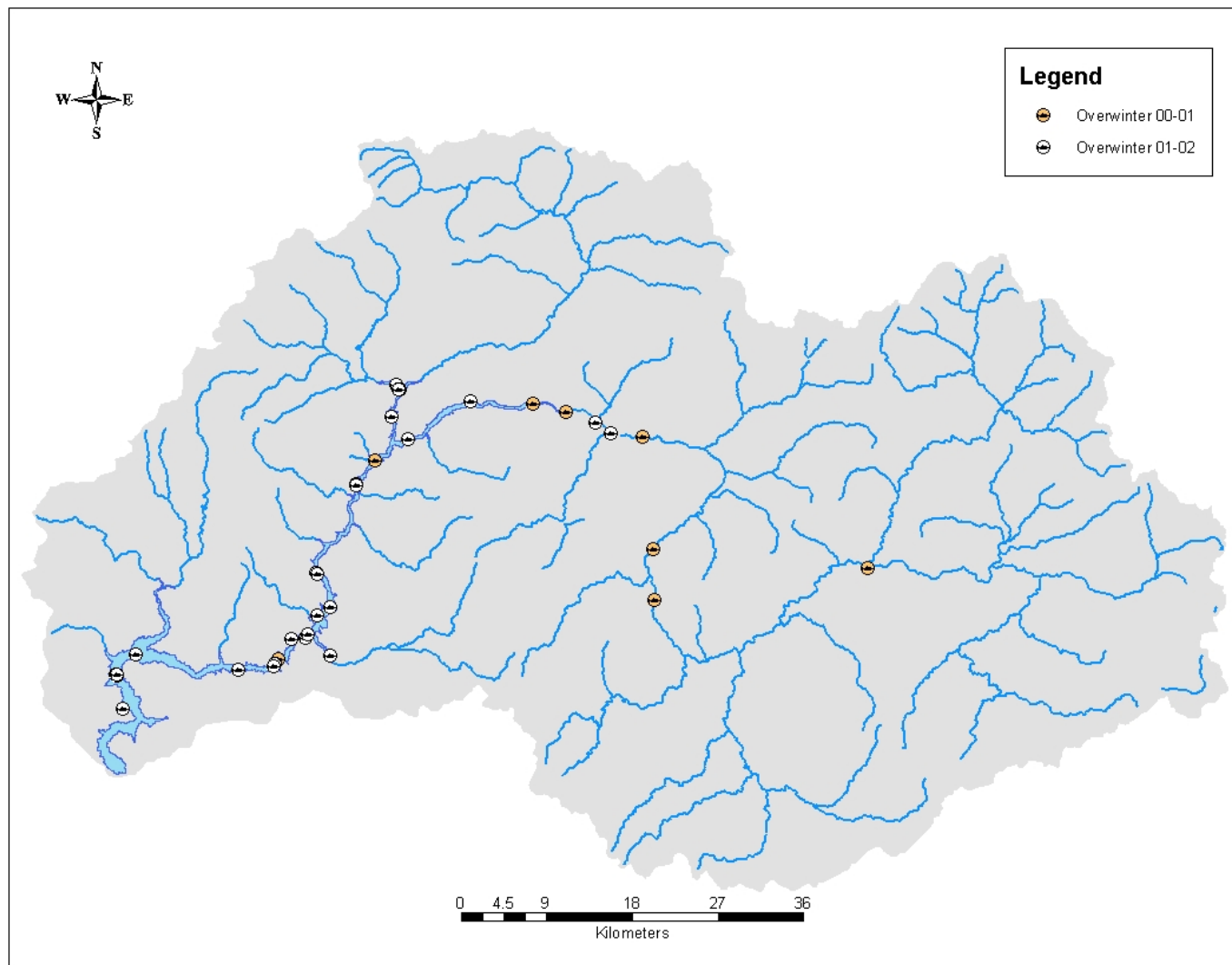


Figure 7. Distribution of all radio-tagged bull trout detections during the overwintering time period, 01 November through 30 April, in the North Fork Clearwater River.

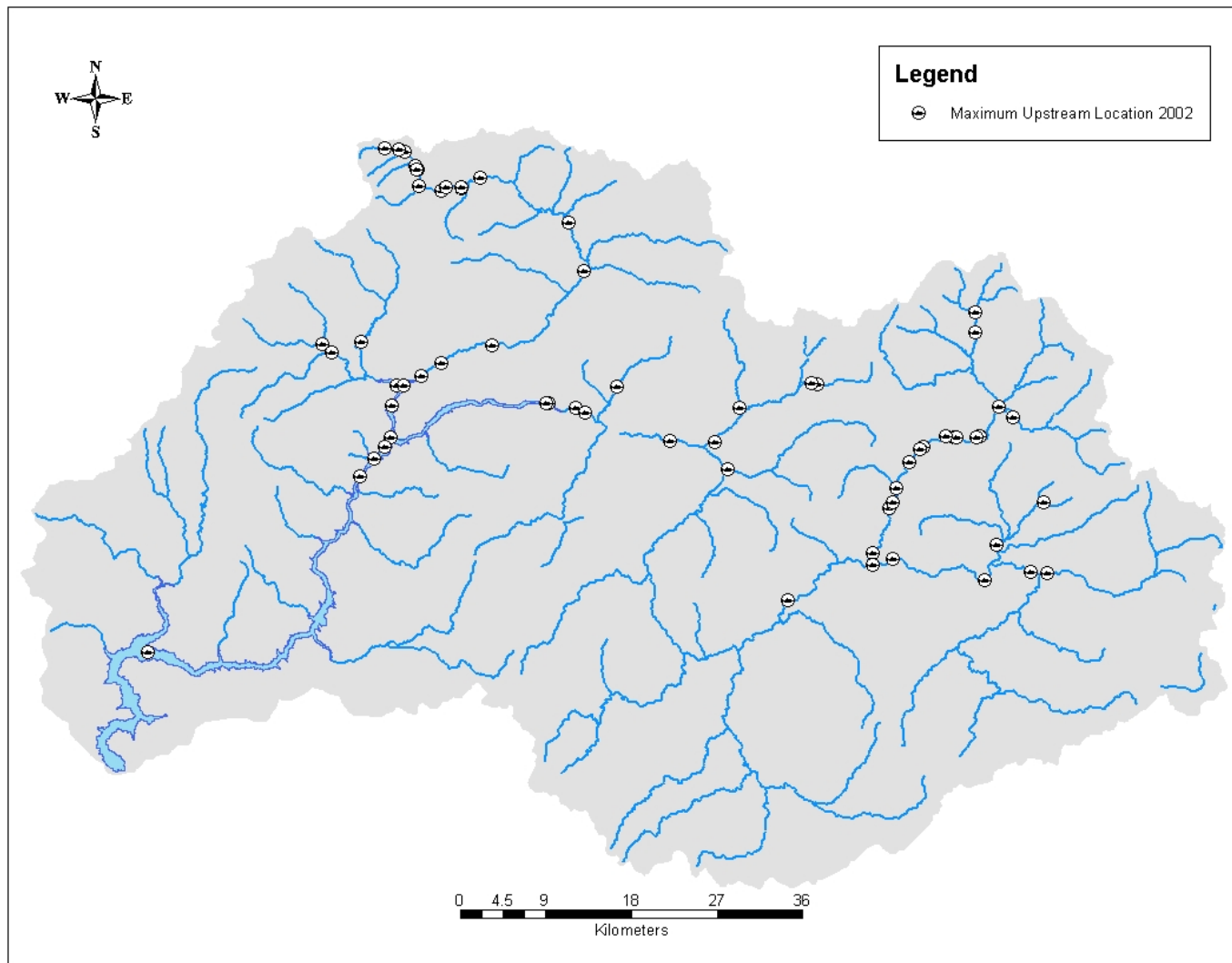


Figure 8. Distribution of radio-tagged bull trout at their maximum migration point in the North Fork Clearwater River, 2002.

Bull trout remaining in Dworshak Reservoir were separated into three watershed groups: Lower NFCR, Middle Dworshak Reservoir, and NFCR. The Lower NFCR and NFCR watershed groups consisted of four and five radio-tagged bull trout, respectively, (Table 4). The Lower NFCR fish were distributed between rkm 61.0 and rkm 66.5 (Figure 8). One of the radio-tagged bull trout in the NFCR watershed group was in Isabella Creek, the other three fish were distributed in the mainstem NFCR between rkm 85.8 and rkm 91.9. There was one radio-tagged bull trout in the Middle Dworshak Reservoir watershed group (Table 4) it was located at rkm 20.5 (Figure 8).

Life History Information

Length-weight relationship

The length-weight relationship for these bull trout is described by the equation: $\log \text{ weight} = 3.3551 \log \text{ total length} - 5.9765$ (Figure 9). This is similar to the value obtained by Hyatt and Hubert 2000 ($\log \text{ weight} = 3.115 \log \text{ total length} - 5.327$).

Migration Patterns

Radio-tagged bull trout migrated an average upstream distance of 67.3 km (range = 0.0-152.7 km) (Appendix 3). Migration past fixed sites and into riverine habitat began on 10 June 2002, and continued through July and August, however only three fish were detected on a fixed site in August (Appendix 2; Table 3). The first radio-tagged bull trout was detected in a known spawning tributary on 6 August 2002, the last on 19 September 2002. There may be a portion of the NFCR bull trout population that enters a tributary for a few days to spawn, but due to our biweekly tracking schedule were not detected in a tributary.

Spawning Frequency

Tracking of post spawning adults in 2001-2002 found 31% (19/61) of radio-tagged bull trout in NFCR retained their radio transmitters and survived through spawning to overwinter in downstream locations (Table 3). All returned to Dworshak Reservoir and were distributed between rkm 12.2 and rkm 91.9. We documented 74% (14/19) of the surviving bull trout migrating from Dworshak Reservoir in 2002 (Table 3). Sixty-three percent (12/19) migrated to spawning areas and are believed to be repeat spawners. One was located in the mainstem LNF and it is uncertain if it was a repeat or alternate year spawner. Thirty-two percent (6/19) remained in Dworshak Reservoir throughout the summer and are believed alternate year spawners. The Upper LNF watershed group had the highest number of repeat spawners, five bull trout returned to this area in 2002 (Table 3).

Seven fish were tagged post-spawn in 2001 and tracked throughout the study period (Table 3). Six of these fish were located in spawning areas in 2002 (Table 3) and one was

Table 4. Number of radio-tagged bull trout detected in each watershed group. The average migration distance is the average of all maximum kilometers traveled by all bull trout within a watershed group.

Subbasin	Watershed Group (5th Field HUC)		Number of Bull Trout 2000	Number of Bull Trout 2001	Number of Bull Trout 2002	Mean migration distance from tagging location (rkm) 2002
NFCR	Beaver Creek		1	1		
	Cold Springs Creek		1	2	5	86.4
	Collins Creek			1	3	41.8
	Headwaters NFCR		3	5	2	141.7
	Kelly Creek		2		3	108.4
	Larson Creek			1		
	Long Creek		4	6	12	111.8
	Lost Pete Creek		3	2	2	25.4
	Osier Creek		1	2	2	113
	Quartz Creek			2	1	26.4
	Schofield Creek			2		
	Upper Weitas Creek		1	1		
LNF	Canyon Creek			3		
	Floodwood Creek			5	1	7.5
	Stony Creek			2	2	20.2
	Middle LNF			7	8	5.1
	Upper LNF			19	15	62.6
Dworshak Reservoir	Lower	Dworshak	1			
	Reservoir					
	Lower NFCR			3	4	-8.2
	Middle	Dworshak			1	-34
	Reservoir					
	NFCR		4	12	5	21.2
	Upper	Dworshak		6		
	Reservoir					
Unknown Detected at Fixed Site Only			2	3		
Unknown Not Detected After Tagging				26	10	

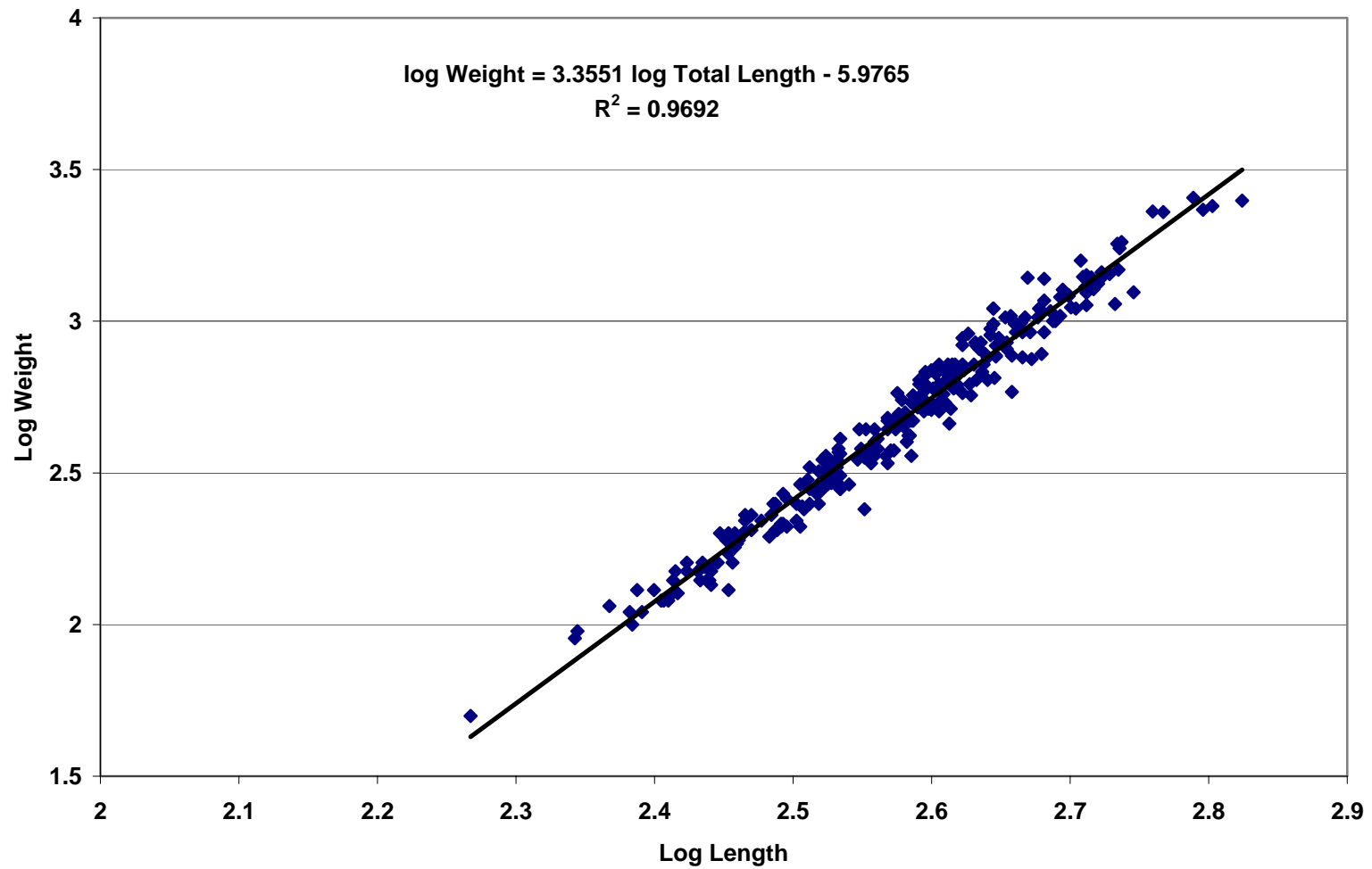


Figure 9. Log length-weight comparison for bull trout captured in the North Fork Clearwater River Drainage 2002.

located in Dworshak Reservoir. Since these fish were tagged after spawning it is unknown if these fish spawned in 2001 and are repeat or alternate year spawners.

Site Fidelity

Forty-six percent (6/13) of the fish believed to be repeat year spawners were detected in different watersheds in 2002 than they were in 2001 (Table 3). The most extreme case of wandering we documented was radio tagged bull trout 150.01.008. This fish was located in the Upper LNF watershed group in 2001 and it was located in the Long Creek watershed group in 2002 (Table 3). This fish showed no apparent site fidelity between years, moving a total of 147.3 km throughout the year, and moving between two different subbasins of the NFCR. Radio-tagged bull trout 148.48.015, migrated into the Stony Creek watershed group in 2001 and the Upper LNF watershed in 2002 (Table 3). Alternatively, radio-tagged bull trout 148.48.012 was documented in the Canyon Creek watershed in 2001 and then in the Floodwood Creek watershed group in 2002 (Table 3). These two bull trout remained in the same subbasin but migrated into substantially different watershed groups in the subsequent year. This required these bull trout to migrate out of the reservoir at different locations, either from the LNF or from BFC. Two radio-tagged bull trout (148.48.004 and 148.48.007) were documented in the Long Creek watershed in 2001; both migrated into the Osier Creek watershed in 2002 (Table 3). These fish displayed two of the four highest overall migration distances, migrating a total of 438.1 km and 305.2 km, respectively, in a year and a half (Table 3). The last radio-tagged bull trout (148.93.036) to migrate into an alternative watershed migrated into the Quartz Creek watershed group in 2001 and then into the Long Creek watershed group in 2002 (Table 3). It is unclear if this fish spawned in 2001 or if it moved into this area for coldwater refuge or food availability.

Radio-tagged bull trout 148.48.020 returned to approximately the same location in both years. This fish traveled the greatest distance of all repeat spawners, an estimated 441.3 km from time of tagging to its second presumed spawning location (Table 3). This fish was migrating downstream again in the fall of 2002, before its transmitter is believed to expired. Radio-tagged bull trout 148.48.002 returned to approximately the same location both years. This fish traveled 53.6 km downstream from its presumed spawning location to its overwintering area in 2001 (Table 3). It migrated upstream 55.4 km in 2002, and was documented returning to Quartz Creek (Table 3). The Upper LNF watershed group had the highest number of repeat spawners, five bull trout returned to this area in 2002 (Table 3).

Redd Surveys

Bull trout redd surveys were conducted from 5 – 25 September 2002 in Isabella, Lake, Long, Osier, and Swamp creeks and Vanderbilt Gulch in the NFCR. Isabella, Skull and Quartz creek had a high number of kokanee spawning in them and it decreased our ability to correctly identify bull trout redds from kokanee redds in these drainages. In the LNF redd surveys were conducted on the mainstem upper LNF and Butte, Lost Lake, Little Lost Lake, Lund, and Rocky Run creeks. Redd surveys were also completed on Floodwood and Stony creeks. Forty-eight redds were located within the NFCR drainage, with the highest number of redds observed in

Vanderbilt Gulch (Table 5, Appendix 4). In the LNF, 40 bull trout redds were observed, with the highest number of redds observed in the upper mainstem LNF above Forest Service road 301 (Table 5). There were no redds observed in Little Lost Lake and Lost Lake creeks. There were four redds found in each survey area of Floodwood and Stony creeks.

Relative Abundance /Population Estimate

Relative abundance of all bull trout observed was calculated in nine different watersheds: mainstem LNF, Black Canyon, Skull, Long, Quartz, Moose, Swamp, Kelly and Isabella creeks. A total of 57 transects were snorkeled, densities of adult bull trout per transect ranged from 0.00 – 1.68/100m² (Table 6). Mean densities of observed bull trout in each watershed were: LNF 0.29/100m²; Skull Creek 0.28/100m²; Long Creek 0.27/100m²; Quartz Creek 0.17/100m²; Moose Creek 0.00/100m²; Swamp Creek 0.08/100m²; Kelly Creek 0.01/100m²; Black Canyon 0.07/100m²; and Isabella Creek 0.29/100m² (Table 7).

Bull trout population estimates were conducted in July and August. We estimated an average density of 18.25 (+/- 41.2%, 95%CI) adult migratory bull trout per river kilometer in areas we documented containing pre-spawning aggregates. The adult migratory population estimate is 1477 (868-2345, 95%CI, Table 8). This estimate is not for the entire drainage but for only those areas where there are known concentrations of pre-spawning migratory bull trout. A confidence limit was not calculated for this estimate due to uncertainties in estimating the amount of habitat being utilized by pre-spawn aggregates.

Table 5. Number of redds observed in each survey area.

Stream	Dates Surveyed	Number of Redds
North Fork Clearwater		
BlackCanyon (mainstem)	9/28/02	1
Isabella Creek	9/05/02	1
Lake Creek	9/06/02 & 9/20/02	20
Long Creek	9/07/02 & 09/20/02	5
Osier Creek	9/19/02	2
Swamp Creek	9/05/02	1
Vanderbilt Gulch	9/07/02 & 9/23/02	18
	Total Redds	48
Little Fork Clearwater		
Butte Creek	9/10/02	2
Little Lost Lake Creek	9/09/02	7
Lund Creek	9/09/02 & 9/25/02	10
Rocky Run Creek	9/10/02 & 9/25/02	6
Upper Little N.F.	9/09/02 & 9/25/02	15
	Total Redds	40
Breakfast Creek		
Floodwood Creek	9/24/02	4
Stony Creek	9/24/02	4
	Total Redds	8

Table 6. Density of fish identified during snorkel surveys in the North Fork Clearwater River Drainage, 2002.

Stream	Transect	Area (m ²)	Rainbow trout			Cutthroat trout			Bull trout		
			<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
Little North Fork Clearwater	129-6-A	1317	0.08		0.08	1.29		1.29		0.15	0.15
Little North Fork Clearwater	129-6-B	1309	1.07	0.08	1.15	0.46	0.08	0.53			
Little North Fork Clearwater	142-25-A	1498	0.13		0.13	1.54	0.07	1.60	0.07		0.07
Little North Fork Clearwater	142-25-B	997	0.20		0.20	1.10		1.10	0.30	0.20	0.50
Little North Fork Clearwater	151-25-A	1526	0.07	0.07	0.13	0.72	0.39	1.11		0.07	0.07
Little North Fork Clearwater	151-25-B	1272				0.71	0.39	1.10	0.08	0.31	0.39
Little North Fork Clearwater	13-24-A	1335	0.07		0.07	1.35	0.15	1.50		0.07	0.07
Little North Fork Clearwater	13-24-B	1136	0.53		0.53	0.70		0.70			
Little North Fork Clearwater	67-7-A	1650	0.06		0.06	1.33	0.06	1.39	0.06	0.12	0.18
Little North Fork Clearwater	67-7-B	1602	0.25		0.25	2.56		2.56			
Little North Fork Clearwater	129-6-C	1331				3.53	0.30	3.83	0.08	0.23	0.30
Little North Fork Clearwater	129-6-D	1485	0.34	0.07	0.40	1.55		1.55	0.07		0.07
Little North Fork Clearwater	13-25-A	1417				1.76	0.07	1.84	0.07	0.14	0.21
Little North Fork Clearwater	13-25-B	867	0.58	0.12	0.69	3.92	0.23	4.15	0.46		0.46
Little North Fork Clearwater	140-25-A	1250	0.72		0.72	0.40		0.40	0.16	0.32	0.48
Little North Fork Clearwater	140-25-B	1183	0.08		0.08	3.30	0.17	3.47			
Little North Fork Clearwater	75-7-A	889	0.22		0.22	2.47		2.47	0.34	0.22	0.56
Little North Fork Clearwater	75-7-B	790				3.42		3.42	0.38	0.25	0.63
Little North Fork Clearwater	137-25-A	980	0.31		0.31	1.12	0.10	1.22	0.41	0.10	0.51
Little North Fork Clearwater	137-25-B	923				1.62		1.62	0.43		0.43
Little North Fork Clearwater	139-25-A	1246				0.80		0.80	0.24	0.08	0.32
Little North Fork Clearwater	139-25-B	1102	0.09		0.09	0.54		0.54		0.09	0.09
Little North Fork Clearwater	10-25-A	1604	0.69		0.69	5.74	0.31	6.05	0.12	0.12	0.25
Little North Fork Clearwater	10-25-B	1509	1.19		1.19	1.79	0.07	1.86			
Little North Fork Clearwater	141-25-A	1598	0.25		0.25	1.94	0.06	2.00	0.06	0.06	0.13
Little North Fork Clearwater	141-25-B	2684	0.04		0.04	0.67		0.67			
Little North Fork Clearwater	4-25-A	1459	0.89		0.89	1.85	0.21	2.06	0.14		0.14

Table 6, Continued.

Stream	Transect	Area (m ²)	Rainbow trout			Cutthroat trout			Bull trout		
			<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
Little North Fork Clearwater	4-25-B	1719	0.17	0.06	0.23	2.97	0.06	3.02			
Little North Fork Clearwater	22-22-A	750				2.40		2.40	0.53	0.27	0.80
Little North Fork Clearwater	22-22-B	909	0.11		0.11	1.98		1.98	0.22	0.55	0.77
Little North Fork Clearwater	7-25-A/13-23-A	714				1.40		1.40	0.14	1.54	1.68
Little North Fork Clearwater	7-25-B/13-23-B	845				3.08	0.12	3.20	0.12	0.24	0.36
Little North Fork Clearwater	7-25-C/13-23-C	714				3.92		3.92			
Skull Creek	113-6-A	1159	0.60		0.60	2.59	0.09	2.67	0.52	0.09	0.60
Skull Creek	113-6-B	1968	0.97		0.97	0.66	0.05	0.71	0.05		0.05
Skull Creek	122-6-A	1247	1.20		1.20	5.77	0.32	6.09	0.08	0.24	0.32
Skull Creek	122-6-B	1262	1.11		1.11	3.72	0.55	4.28	0.08	0.08	0.16
Long Creek	148-25-A	667				0.90		0.90	0.30		0.30
Long Creek	148-25-B	848				0.71		0.71	0.24		0.24
Quartz Creek	2-24-A	790	6.08		6.08	5.70	0.13	5.83		0.25	0.25
Quartz Creek	2-24-B	1050	2.09		2.09	6.76	0.19	6.95		0.10	0.10
Moose Creek	4-24-A	620	0.48		0.48	1.94	0.48	2.42			
Moose Creek	4-24-B	605	0.50		0.50	1.65	0.33	1.99			
Swamp Creek	154-25-A	622	0.96		0.96	0.32	0.32	0.64		0.16	0.16
Swamp Creek	154-25-B	722	0.14		0.14	0.55	0.83	1.38			
Kelly Creek	1-24-A	2413				0.50	0.66	1.16			
Kelly Creek	1-24-B	2601					0.12	0.12			
Kelly Creek	131-6-A	4099				0.05	0.66	0.71		0.02	0.02
Kelly Creek	131-6-B	2592				0.15	0.31	0.46			
Black Canyon	117-6-A	2567	0.04	0.04	0.08	0.70	0.39	1.09	0.04	0.08	0.12
Black Canyon	117-6-B	2411				0.66	0.08	0.75			
Black Canyon	119-6-A	1722	0.75	0.06	0.81	0.64	0.41	1.05	0.12	0.06	0.17
Black Canyon	119-6-B	1233	1.22	0.08	1.30	0.49	0.49	0.97			

Table 6, Continued.

Stream	Transect	Area (m ²)	<u>Rainbow trout</u>			<u>Cutthroat trout</u>			<u>Bull trout</u>		
			<305 mm	>305 mm	Total	<305 mm	>305 mm	Total	<350 mm	>350 mm	Total
Isabella	145-25A	1020	3.14		3.14	2.16	0.20	2.35		0.78	0.78
Isabella	145-25B	900	1.33		1.33	4.33		4.33		0.11	0.11
Isabella	089-07A	1067	0.28		0.28	0.66	0.09	0.75	0.09	0.19	0.28
Isabella	089-07B	1067	0.28		0.28	1.59		1.59			

Table 7. Mean density of bull trout observed while snorkeling in each watershed.

	LNF	Skull Creek	Long Creek	Quartz Creek	Moose Creek	Swamp Creek	Kelly Creek	Black Canyon	Isabella Creek
Mean	0.29	0.28	0.27	0.17	0.00	0.08	0.01	0.07	0.29
Median	0.18	0.24	0.27	0.17	0.00	0.08	0.00	0.06	0.20
Standard Deviation	0.34	0.24	0.05	0.11	0.00	0.11	0.01	0.09	0.35
Sample Variance	0.12	0.06	0.00	0.01	0.00	0.01	0.00	0.01	0.12
Minimum	0.00	0.05	0.24	0.10	0.00	0.00	0.00	0.00	0.00
Maximum	1.68	0.60	0.30	0.25	0.00	0.16	0.02	0.17	0.78
Sample Size	33	4	2	2	2	2	4	4	4
Confidence Level (95%)	0.12	0.38	0.41	1.00	0.000	1.02	0.02	0.14	0.55

Table 8. Estimated number of adult bull trout by estimated spawning aggregate.

Drainage	Stream Name	Stream Length (km)	Total Number of Adult Bull Trout
North Fork Clearwater River			
	Lake Creek	7.0	128.2
	Skull Creek	5.7	103.9
	Quartz Creek	1.6	29.3
	Isabella Creek	6.4	116.9
	Moose Creek	1.8	32.1
	Long Creek	2.6	47.6
	Vanderbuilt Gulch	6.6	120.7
	Bostonia Creek	1.3	23.9
	Mainstem: Vanderbuilt Gulch to Meadow Creek	3.0	54.8
	Black Canyon: Pete Ott Creek to Hidden Creek	14.0	255.4
Little North Fork Clearwater River			
	Canyon Creek	6.3	115.2
	Stony Creek	2.1	37.9
	Floodwood Creek	3.6	65.8
	Mainstem: Twin Creek to Washed out upper most bridge	18.9	345.0
	Total Number of Spawning Bull Trout in 2003		1476.6

DISCUSSION

Migration

Migration from Dworshak Reservoir occurred later in 2002 than in 2001. Ninety-eight percent of the bull trout that migrated from the reservoir in 2001 had moved above a fixed site by 14 July 2001, compared to 89% by 21 July 2002. The late migration timing is evident in their arrival timing to spawning locations. Fish continued to move into spawning areas until 19 September 2002. Fish did not move into spawning areas past the end of August in 2001. The cause of the late migration timing is believed influenced by the late spring flow conditions experienced in the NFCR. The normal high spring flow period is from late April to mid May and flows are usually declining by the first of June. High spring flows continued throughout June in 2002. The late spring flows appeared to delay fish migration from the reservoir.

The late spring flows and late arrival of radio-tagged bull trout into tributaries delayed timing of our population estimates. In 2001, the majority of radio-tagged bull trout had entered tributaries that were feasible to snorkel and had favorable water conditions (high visibility and low flows) for snorkeling by mid-July (Figure 10). These fish would then remain in these general locations until late August, prior to spawning (Figure 11). However, in 2002, fish were still heavily concentrated in the mainstem NFCR and LNF in mid-July, where snorkeling was not feasible (Figure 12). Also, we did not believe bull trout would remain in these areas. Due to these conditions we waited until late July before beginning our snorkeling population estimate work. By August radio-tagged fish reached similar upstream areas as in previous years, they were just two to three weeks behind the 2001 migration pattern (Figure 13).

Radio-tagged bull trout were observed in the mainstem NFCR in late October 2002. In previous years radio-tagged fish quickly descended back to Dworshak Reservoir where they would remain throughout the winter and early spring. In 2002, we captured and observed bull trout in the mainstem NFCR on or near kokanee redds. These bull trout were observed actively feeding on kokanee and their eggs. Initial results from dietary analysis have found that samples taken at this time solely contain whole kokanee and/or their eggs. Stomach contents and dietary analysis will be completed in 2003.

More bull trout were tracked during the 2001 – 2002 overwintering time period than in previous years. The increased number of bull trout tracked has allowed for documentation of additional areas utilized in the reservoir during this time period. There is high bull trout use from rkm 30.1 to rkm 49.9. This may represent the historical downstream migration limit and overwintering areas of these fish. Prey availability in the different areas of the reservoir will need to be documented to determine if these fish are concentrating in this area because of a greater prey base or another reason. Through the addition of acoustic transmitters this year we expect to get more information on the distribution of bull trout utilizing the reservoir throughout the overwintering period.

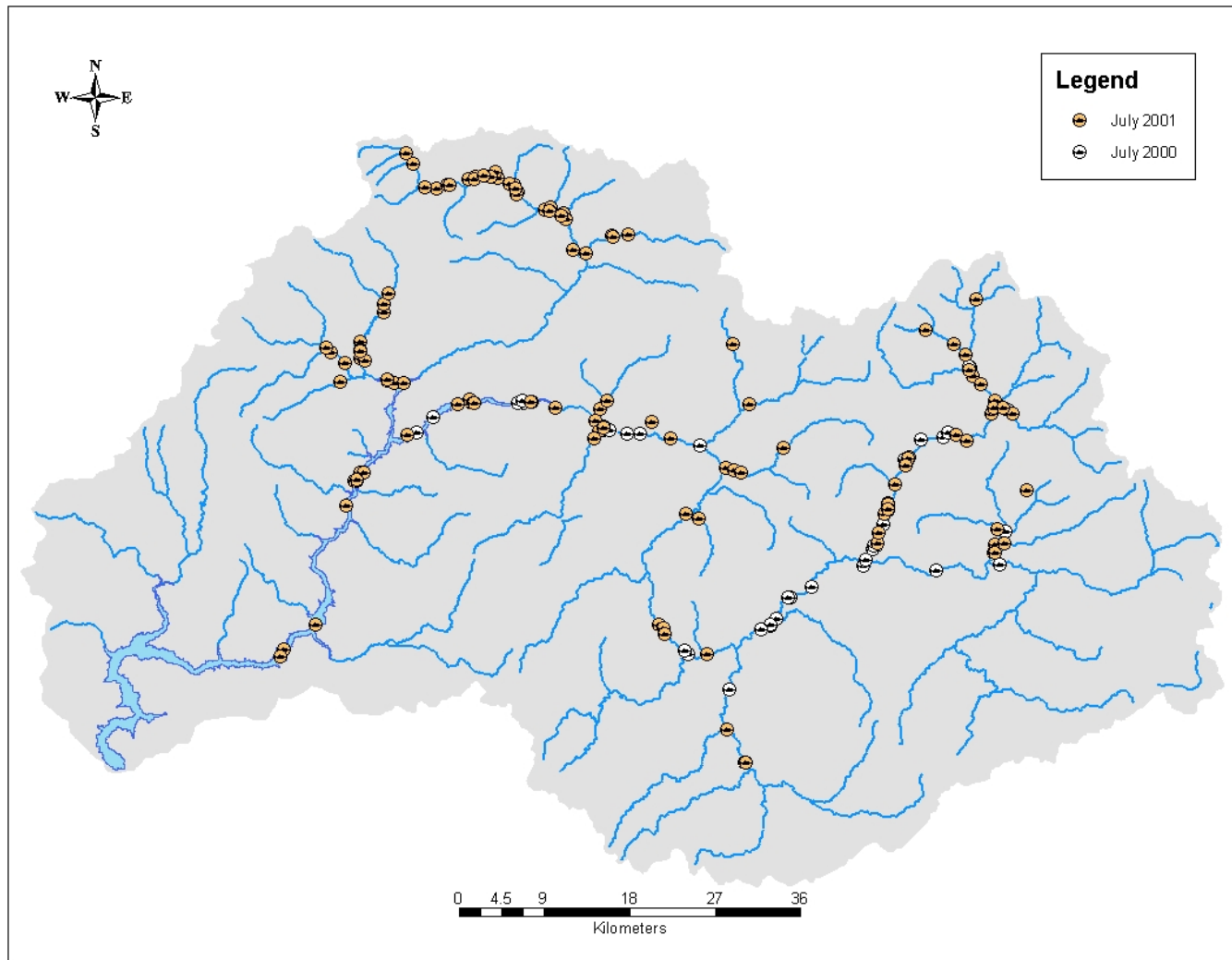


Figure 10. Distribution of radio-tagged bull trout in July 2000 and July 2001 in the North Fork Clearwater River drainage.

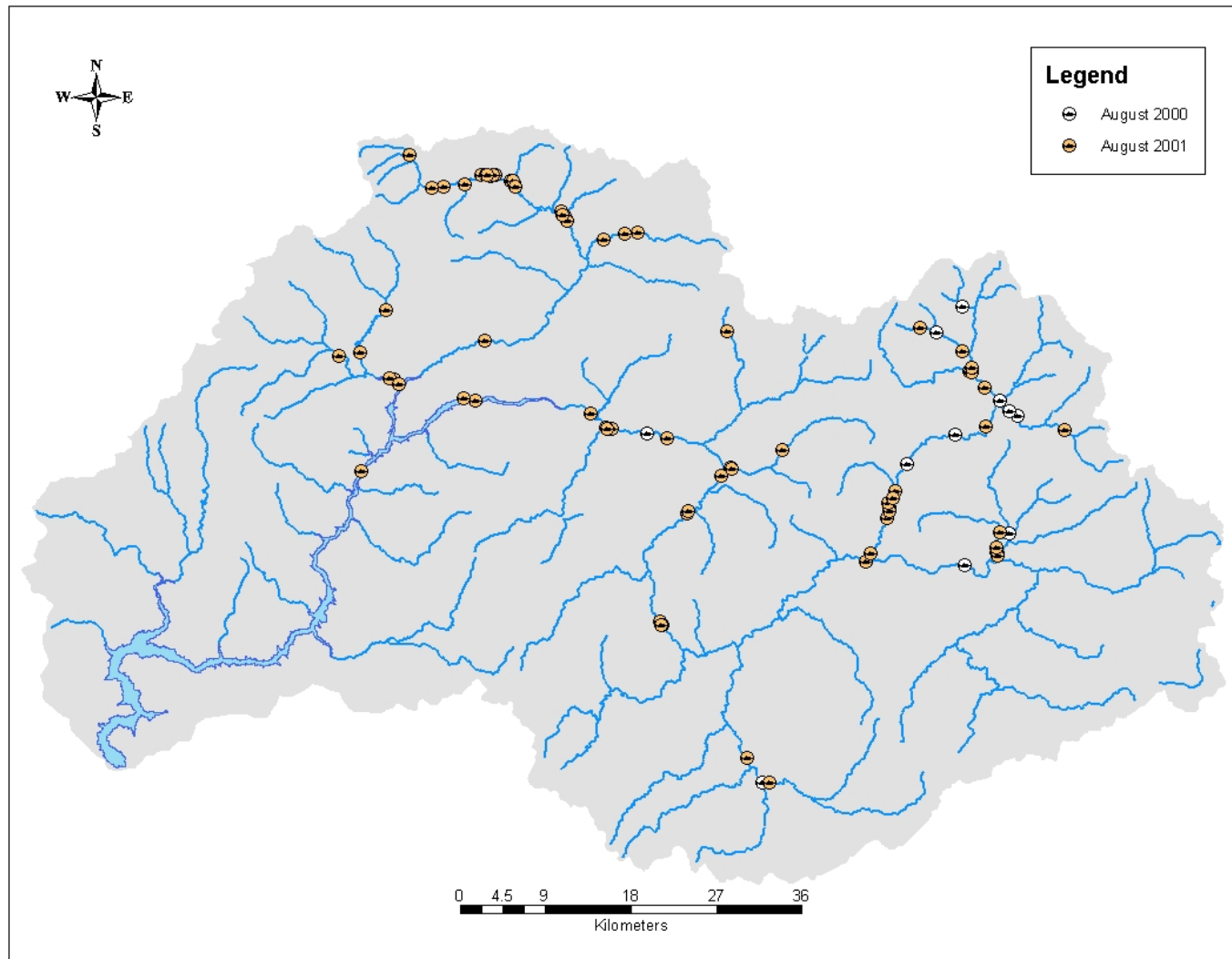


Figure 11. Distribution of radio-tagged bull trout in August 2000 and 2001 in the North Fork Clearwater River drainage.

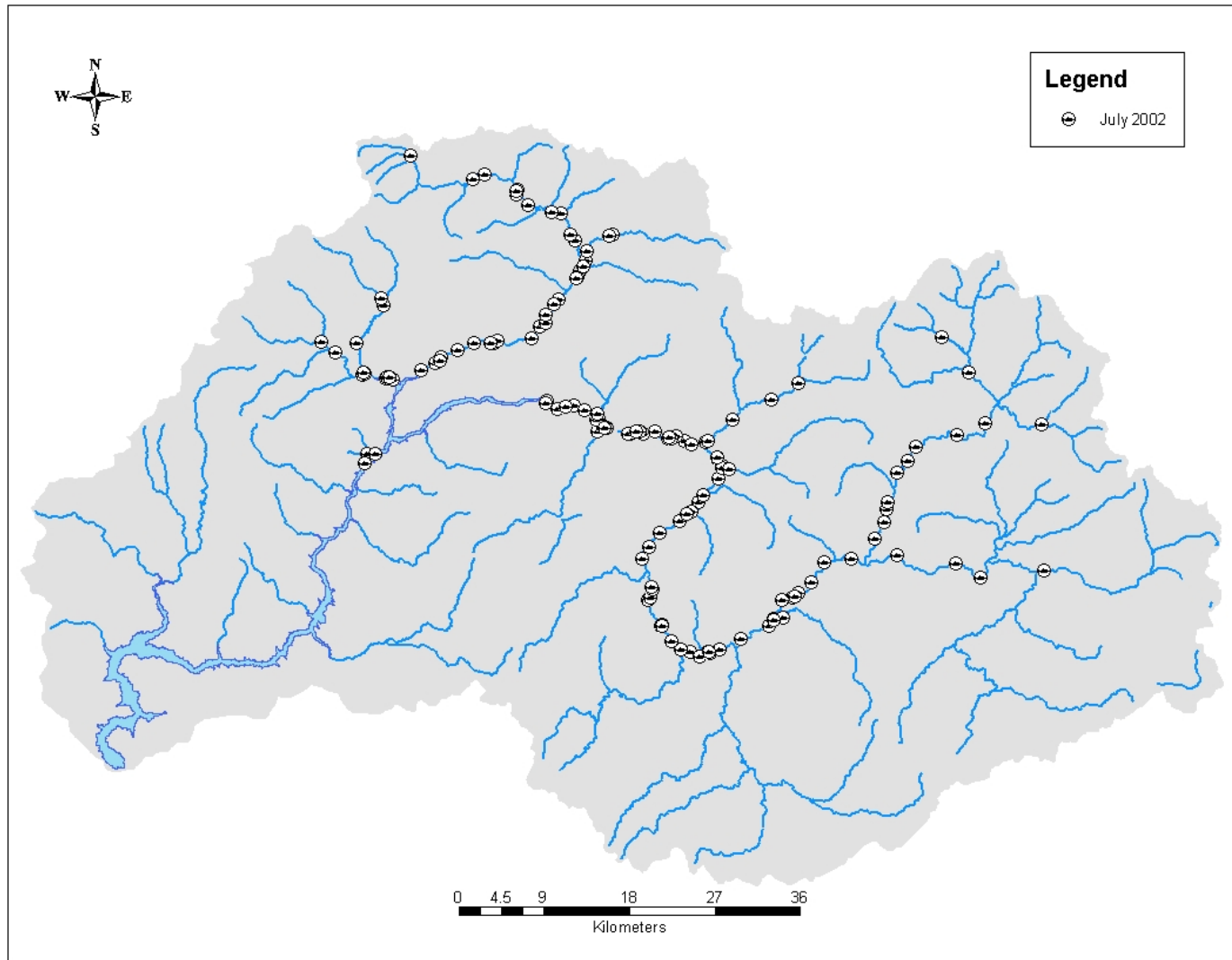


Figure 12. Distribution of radio-tagged bull trout in July 2002 in the North Fork Clearwater River.

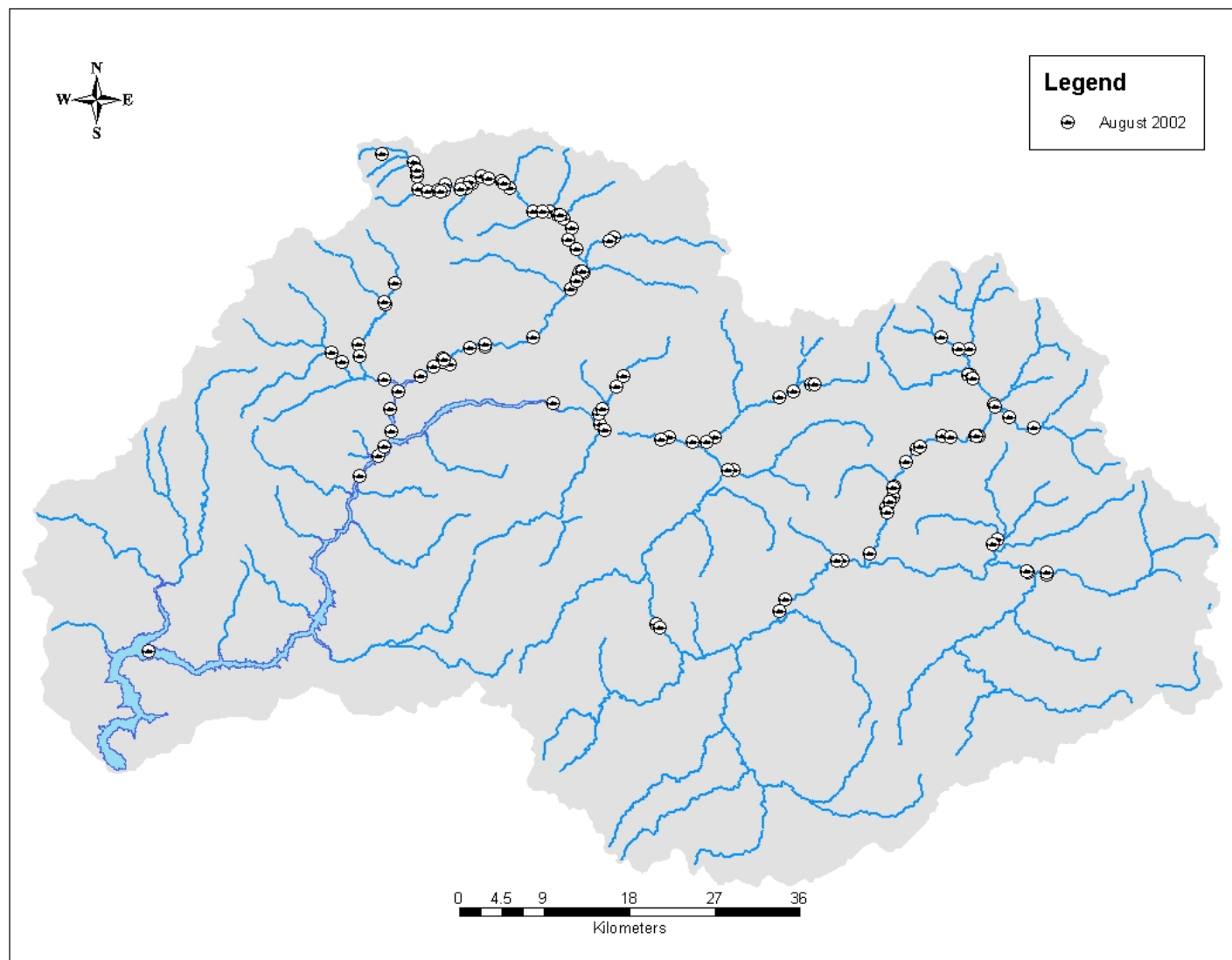


Figure 13. Distribution of radio-tagged bull trout in August 2002 in the North Fork Clearwater River drainage.

Spawning

Radio-tagged bull trout were documented spawning in four previously undocumented drainages in 2002. Currently, it is unclear the abundance of adults in these spawning aggregates. These areas will be further investigated in 2003.

Bull trout were first documented initiating spawning later this year than in the previous years. In 2000 and in 2001, bull trout were seen actively constructing redds in the last week of August (Cochner et al. 2001, Schriever and Schiff 2003). In 2002, bull trout were not observed constructing redds until the second week of September. This may be attributed to late spring run-off that caused bull trout to migrate later in the year.

Alternate- and repeat- year spawning is known to occur in bull trout populations. Allan (1980) found 73% of adult bull trout tagged in Timber Creek, Alberta did not return to spawn the following year. Bull trout in Rapid River, Idaho, showed 66-80% of post-spawning survivors spawned the next year (Elle et al. 1994). In Dworshak Reservoir we documented 74% (13/19) radio-tagged bull trout returning to spawning areas in consecutive years. This is higher than the 50% estimate reported in 2001, when the sample size was small consisting of six individuals (Schriever and Schiff 2003).

Post-spawning survival is estimated at 76% (37/49) for radio-tagged bull trout. This is significantly higher than documented in 2000 and in 2001, where post-spawning survival was estimated at 40% and 31%, respectively (Cochner et al. 2001, Schriever and Schiff 2003). Previous estimates were comparable to 31% post-spawning survival reported for bull trout in Rapid River (Schill et al. 1994). It is unclear why survival was substantially higher in 2002.

Population Estimate

The current population of adult migratory bull trout throughout areas surveyed in the North Fork Clearwater River Drainage is estimated at 1477 (868-2345, 95% CI). This likely represents a minimum estimate because there are areas known to contain pre-spawning fish that we were unable to survey or use in the estimate. These areas were not surveyed due to the remoteness of the location and the time required to access them. Furthermore, it is unrealistic to believe we have identified all potential locations where aggregates of pre-spawning bull trout may occur. Therefore, further identification and inclusion of these areas would increase the adult population estimate.

We know pre-spawning aggregates of bull trout are not uniformly distributed across the landscape. We determined areas where pre-spawn aggregates occurred based on the presence of radio-tagged bull trout. The total area actually encompassed by each pre-spawning aggregate may be larger than we delineated because radio-tagged bull trout may not have necessarily been distributed at the maximum distribution of the aggregate. To more accurately determine the total population size, additional effort is going to be required to determine bull trout habitat preference

during pre-spawn aggregation, the amount and availability of these habitat types and additional areas in the watershed where these habitats are located.

The second year of this study documented trends in migration patterns and identified riverine habitat areas utilized seasonally by bull trout. Continuation of the study will include tracking bull trout within the reservoir through the use of acoustic and radio transmitters and completion of dietary analysis and prey availability. Additionally, bull trout will be captured in the spillway of Dworshak Dam and radio-tagged to determine if these fish migrate out of the NFCR, and if they do which drainage they immigrate into, and if spawning occurs. Additional habitat characteristics of areas utilized by bull trout will be also be collected to further enhance our ability to estimate the population size of adult bull trout.

ACKNOWLEDGEMENTS

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APPENDIX

Appendix A. Table 1. All bull trout captured in the North Fork Clearwater River drainage, 2002.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
52581A4426		4/17/2002	258	244	125	N	DWR
523A70093B		4/17/2002	261	245	127	N	DWR
523A50035E		4/17/2002	292	282	202	N	DWR
52390E1853		4/17/2002	221	210	95	N	DWR
5221428410		4/17/2002	244	230	130	N	DWR
204214701A		4/17/2002	259	242	140	N	DWR
52213D373F	149.42.088	4/18/2002	337	323	293	N	DWR
525C4B0E7F		4/23/2002	287	275	180	N	DWR
20431A5132	149.42.089	4/24/2002	304	289	195	N	DWR
525C464E67	149.42.087	4/25/2002	342	330	310	N	DWR
416E717F62	148.77.008	4/25/2002	455	434	585	Y	DWR
2041723574		4/25/2002	276	261	135	N	DWR
52575D476A	149.44.069	5/2/2002	419	396	580	N	BFC
51664C3C1F	149.44.067	5/2/2002	407	390	700	N	BFC
525803371A	149.44.064	5/2/2002	451	431	810	N	BFC
5258017A7B	149.42.085	5/2/2002	362	350	400	N	BFC
5257230501	149.42.065	5/2/2002	557	547	1245	N	BFC
20420B4C47	149.42.063	5/2/2002	540	518	1140	N	BFC
200A44345E	149.42.062	5/2/2002	515	498	1130	N	BFC
416E717F62	148.77.008	5/3/2002	455	431	770	Y	DWR
5257277113		5/3/2002	321	305	245	N	DWR
52213B7720	149.44.076	5/4/2002	423	411	910	N	NFC
52573E647B	149.44.075	5/4/2002	519	498	1360	N	LNF
201E284F50	149.44.065	5/4/2002	401	385	670	N	LNF
5258024F4C	149.44.063	5/4/2002	514	495	1295	N	LNF
5047387441	149.44.061	5/4/2002	495	481	1270	N	LNF
52573D4F63		5/4/2002	375	370	440	N	LNF
416F636A4A		5/4/2002	457	440	990	Y	LNF
52573F723F		5/5/2002	257	250	120	N	DWR
5221370A0D		5/5/2002	284	273	171	N	DWR
1BF141C971	149.44.074	5/6/2002	393	381	505	N	DWR
1BF141B260	149.44.073	5/7/2002	398	380	690	N	NFC
1BF141D142	149.42.131	5/7/2002	370	353	480	N	NFC
1BF141CA31	149.42.130	5/7/2002	342	332	410	N	NFC
1BF141BFED	148.77.135	5/7/2002	415	395	620	N	NFC
1BF141C71E	148.77.134	5/7/2002	434	411	720	N	NFC
1BF141DB43	148.77.133	5/7/2002	412	392	720	N	NFC
1BF142814F	148.77.132	5/7/2002	480	465	1380	N	NFC
1BF141C5F5		5/7/2002	331	317	295	N	NFC
1BF141C167		5/7/2002	325	311	250	N	NFC
1BF141D94F	148.77.136	5/10/2002	432	413	850	N	NFC
1BF141C5F5		5/7/2002	331	317	295	N	NFC

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF141C167		5/7/2002	325	311	250	N	NFC
1BF141D94F	148.77.136	5/10/2002	432	413	850	N	NFC
1BF141B8E1	149.44.072	5/11/2002	408	395	640	N	NFC
1BF141B091	148.77.143	5/11/2002	478	455	780	N	LNF
1BF1422BB3	148.77.142	5/11/2002	480	455	920	N	LNF
1BF1422B7C	148.77.141	5/11/2002	445	422	880	N	LNF
1BF141E733	148.77.140	5/11/2002	487	468	1000	N	LNF
1BF142184B	148.77.139	5/11/2002	476	455	1100	N	LNF
1BF1420A53	148.77.138	5/11/2002	469	446	920	N	LNF
1BF142745C	148.77.137	5/11/2002	528	508	1450	N	LNF
1BF142E864		5/11/2002	320	305	290	N	NFC
1BF1433B80		5/11/2002	407	391	680	N	LNF
1BF1433B56		5/11/2002	334	317	350	N	LNF
1BF142E8E8		5/11/2002	413	392	600	N	LNF
1BF1428CEB		5/11/2002	360	345	340	N	LNF
1BF1428CDF		5/11/2002	390	372	620	N	LNF
1BF1422BAF		5/11/2002	376	357	580	N	LNF
1BF141C552		5/11/2002	437	412	640	N	LNF
1BF141B5D0		5/11/2002	435	428	780	N	LNF
1BF141B6B9	149.42.110	5/12/2002	354	340	380	N	NFC
1BF1421E5F	148.77.150	5/12/2002	506	486	1100	N	LNF
1BF141BD1A	148.77.145	5/12/2002	485	464	1080	N	NFC
1BF141F1BC	148.77.144	5/12/2002	667	647	2500	N	NFC
1BF142E886		5/12/2002	370	351	340	N	NFC
1BF142E86C		5/12/2002	385	365	360	N	NFC
1BF1429FC4		5/12/2002	369	350	360	N	NFC
1BF1421B5B		5/12/2002	342	326	280	N	NFC
1BF141A9DA	148.77.151	5/15/2002	478	455	1080	N	LNF
1BF141EFD2	148.77.148	5/15/2002	527	500	1380	N	LNF
1BF141E715	148.77.147	5/15/2002	515	493	1240	N	LNF
1BF1429557		5/15/2002	384	362	420	Y	LNF
1BF141BE8B		5/15/2002	493	473	1040	N	LNF
1BF141BCAC		5/15/2002	342	323	280	N	LNF
1BF142A9B7	149.42.118	5/16/2002	441	426	980	N	NFC
1BF141C65C	149.42.114	5/16/2002	443	421	770	N	NFC
1BF1421F6D	149.42.113	5/16/2002	424	405	620	N	NFC
1BF1422612	149.42.112	5/16/2002	403	382	720	N	NFC
1BF141B987	149.42.111	5/16/2002	439	423	900	N	NFC
1BF1422B7F	148.77.155	5/16/2002	493	476	1200	N	NFC
1BF141C962	148.77.154	5/16/2002	443	425	765	N	NFC
1BF141CA20		5/16/2002	305	291	230	N	NFC
1BF141B592		5/16/2002	340	322	290	N	NFC

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF1427607	148.93.015	5/17/2002	489	470	1000	N	DWR
1BF141AF13	148.93.010	5/17/2002	394	376	620	N	NFC
1BF1421C33		5/17/2002	313	300	210	N	DWR
1BF142BA71		5/18/2002	284	270	130	N	DWR
1BF142A9D0		5/18/2002	241	227	110	N	DWR
1BF1421E69		5/18/2002	254	245	120	N	DWR
1BF14218FC		5/18/2002	242	230	100	N	DWR
1BF141F1C6		5/18/2002	334	320	360	N	DWR
1BF141AF34		5/18/2002	332	316	350	N	DWR
1BF141F2B7	149.42.127	5/19/2002	386	368	570	N	DWR
1BF1421BEA		5/19/2002	292	283	220	N	DWR
1BF141F2A4		5/19/2002	292	280	230	N	DWR
1BF141CA54		5/20/2002	272	259	155	N	DWR
1BF141C759		5/20/2002	335	321	290	N	DWR
1BF141AF08		5/20/2002	307	293	205	N	DWR
1BF141B8F2	148.48.128	5/21/2002	357	345	440	N	DWR
1BF1421E5A		5/21/2002	265	252	160	N	DWR
1BF141B093		5/21/2002	307	294	250	N	DWR
1BF1421F77		5/24/2002	352	333	350	N	LNf
1BF14279D2	148.93.013	5/25/2002	615	5823	2550	N	LNf
1F5C1D1A4E	148.48.013	5/25/2002	543	525	1480	Y	LNf
1BF1422C7E		5/25/2002	374	356	375	N	LNf
1BF141E726		5/25/2002	337	321	295	N	LNf
1BF141C74F		5/25/2002	329	304	270	N	LNf
1BF141BCFB		5/25/2002	330	315	250	N	LNf
1BF141B97B		5/25/2002	372	355	375	N	LNf
1BF1434B72	149.42.129	5/26/2002	502	482	1110	N	LNf
1BF141C019	149.42.125	5/26/2002	410	390	620	N	NFC
1BF141BD1F	149.42.124	5/26/2002	380	362	460	N	NFC
1BF141C54E	149.42.123	5/26/2002	389	374	520	N	NFC
1BF141C2DE	149.42.122	5/26/2002	433	410	680	N	NFC
1BF1422BD4	149.42.120	5/26/2002	370	358	470	N	NFC
1BF1428420	149.42.119	5/26/2002	392	372	530	N	NFC
1BF142A9C8	149.42.117	5/26/2002	385	363	540	N	NFC
1BF141EFE3	149.42.116	5/26/2002	462	441	990	N	NFC
1BF141BB88	149.42.115	5/26/2002	457	434	980	N	NFC
1BF1433B92		5/26/2002	308	297	205	N	NFC
1BF142AEC7		5/26/2002	276	265	150	N	NFC
1BF142A9C5		5/26/2002	275	261	140	N	NFC
1BF142A008		5/26/2002	364	340	380	N	NFC
1BF142822B		5/26/2002	311	297	215	N	NFC
1BF1422B8B		5/26/2002	279	268	160	N	NFC

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF14218F0		5/26/2002	295	282	205	N	NFC
1BF141F2B3		5/26/2002	284	270	200	N	NFC
1BF141EFF1		5/26/2002	360	342	380	N	NFC
1BF141BAAE		5/26/2002	341	332	370	N	NFC
1BF141ACAF		5/26/2002	310	299	215	N	NFC
1BF141BA01	148.91.018	5/27/2002	430	411	820	N	LNF
1BF141B01D		5/27/2002	356	336	355	N	LNF
1BF1433B8C		5/31/2002	358	341	370	N	LNF
1BF1428D0C	148.91.023	6/1/2002	500	480	1210	N	BFC
1BF141DB50	148.91.022	6/1/2002	546	529	1825	N	LNF
1BF1428D0C	148.91.021	6/1/2002	431	411	810	N	LNF
415A261A5A		6/1/2002	333	327	310	Y	LNF
1BF142198E		6/1/2002	379	369	550	Y	LNF
1BF141E726		6/1/2002	331	320	275	Y	LNF
1BF141DB50	148.91.022	6/3/2002	542	526	1800	Y	LNF
1BF144C249		6/3/2002	500	479	1220	N	NFC
1BF141A950		6/3/2002	395	387	670	N	NFC
1BF1433B98		6/4/2002	585	562	2290	N	NFC
1BF14270D8		6/4/2002	419	407	700	N	NFC
1BF1422BA4		6/4/2002	271	269	140	N	NFC
1BF141C93E		6/4/2002	285	272	190	N	NFC
1BF141C574		6/4/2002	419	399	720	N	NFC
1BF141B90A		6/4/2002	382	368	400	N	NFC
1BF141A635		6/4/2002	357	339	370	N	NFC
1BF141676D		6/4/2002	381	374	500	N	NFC
1BF1416205		6/4/2002	255	242	120	N	NFC
1BF1433B7A	148.91.028	6/5/2002	480	46	1170	N	LNF
1BF14214C2	148.91.027	6/5/2002	380	369	450	N	LNF
1BF141BB7D	148.91.030	6/12/2002	383	370	420	N	LNF
1BF142D81E		6/12/2002	310	300	210	N	LNF
1BF14293DF		6/12/2002	340	325	310	N	LNF
1BF1421BE7		6/12/2002	362	351	380	N	LNF
1BF141C5D8		6/12/2002	362	352	360	N	LNF
1BF141B583		6/12/2002	274	262	140	N	LNF
1BF14B8DC3		6/13/2002	407	389	540	N	NFC
1BF14614F7		6/13/2002	385	369	470	N	NFC
1BF145FB3A		6/13/2002	324	304	300	N	NFC
1BF145CBE7		6/13/2002	318	307	220	N	NFC
1BF145C409		6/13/2002	347	331	290	N	NFC
1BF1422B8B		6/13/2002	275	268	140	Y	NFC
1BF141CA4A		6/13/2002	460	445	960	N	NFC
1BF141C5EF		6/13/2002	330	319	280	N	NFC

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF14625E6		6/14/2002	454	446	1040	N	LNF
1BF146150A		6/14/2002	220	211	90	N	LNF
1BF144766C		6/14/2002	300	288	220	N	LNF
1BF14B6C55		6/14/2002	451	440	850	N	BFC
1BF14600AD		6/14/2002	318	301	250	N	BFC
1BF1446F86		6/14/2002	403	386	505	N	BFC
1BF144640E		6/14/2002	415	397	610	N	BFC
1BF14B944F		6/15/2002	288	274	185	Y	NFC
1BF14B944F		6/15/2002	288	274	185	N	NFC
1BF14B83CA		6/15/2002	544	530	1740	N	NFC
1BF1461E7B		6/15/2002	429	411	830	N	NFC
1BF146124B		6/15/2002	275	260	140	N	NFC
1BF1461149		6/15/2002	512	508	1400	N	NFC
1BF1460B69		6/15/2002	287	273	200	N	NFC
1BF1460B5E		6/15/2002	246	233	110	N	NFC
1BF145DEDD		6/15/2002	289	277	190	N	NFC
1BF145DE1C		6/15/2002	390	375	530	N	NFC
1BF1447315		6/15/2002	356	337	240	N	NFC
1BF1446E9A		6/15/2002	295	284	230	N	NFC
1BF144760C		6/16/2002	414	398	650	N	BFC
1BF146124B		6/27/2002	272	261	160	Y	NFC
1BF146122E		6/27/2002	320	305	210	N	NFC
1BF1460B52		6/27/2002	265	258	150	N	NFC
1BF145CBE6		6/27/2002	399	380	530	N	NFC
1BF1445001		6/27/2002	270	265	150	N	NFC
1BF14B8FC5		6/27/2002	273	259	155	N	BFC
1BF14627F6		6/27/2002	185	175	50	N	BFC
1BF1441CA7		6/27/2002	306	293	250	N	BFC
1BF1421BDD		6/27/2002	396	380	515	N	BFC
1BF141C5AF		6/27/2002	443	426	830	N	BFC
1BF145C3A6	148.91.036	6/29/2002	386	374	470	N	LNF
1BF1421BDD	148.91.031	6/29/2002	398	380	510	Y	BFC
1BF144515F	148.48.017	6/29/2002	420	407	690	Y	LNF
1BF14471D7		6/29/2002	325	310	330	N	LNF
1BF1445816		6/29/2002	410	397	460	N	LNF
1BF145DEDA		6/30/2002	286	275	160	N	NFC
1BF14469EA		6/30/2002	283	270	190	N	NFC
1BF144616E		6/30/2002	322	310	240	N	NFC
1BF141DA02	148.91.035	7/1/2002	442	420	650	N	NFC
1BF1462571		7/1/2002	280	270	200	Y	NFC
1BF1462571		7/1/2002	282	271	195	N	NFC
1BF141EFD0		7/1/2002	251	240	130	N	NFC

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF141BEA5		7/1/2002	260	250	150	N	NFC
		7/1/2002	291	281	200	Y	NFC
1BF1690D13	076.80.017	10/4/2002	519	508	1395	N	LNF
1BF1678764	076.80.016	10/4/2002	437	420	760	N	LNF
1BF1679730	076.80.001	10/4/2002	575	564	2300	N	LNF
1BF1694B45		10/4/2002	353	345	440	N	LNF
1BF169A153	076.80.018	10/5/2002	419	405	835	N	LNF
1BF168F809	076.80.015	10/5/2002	409	395	720	N	LNF
1BF168EB05	076.80.014	10/5/2002	475	455	1030	N	LNF
1BF1398B80	076.80.013	10/5/2002	535	520	1430	N	LNF
1BF1394F96	076.80.011	10/5/2002	450	432	1030	N	BFC
1BF168C389	076.80.010	10/5/2002	414	395	670	N	BFC
1BF16944B2	076.80.003	10/5/2002	635	601	2395	N	LNF
1BF168C363	076.80.002	10/5/2002	395	385	540	N	BFC
1BF16A0F4E		10/5/2002	356	345	370	N	LNF
1BF169037D		10/5/2002	341	326	380	N	LNF
1BF1690126		10/5/2002	403	382	620	N	LNF
1BF168A764		10/5/2002	342	329	365	N	LNF
1BF1679956		10/5/2002	370	351	440	N	LNF
1BF169FC73		10/5/2002	374	355	460	N	BFC
1BF168AF08	076.80.006	10/6/2002	439	425	945	N	BFC
1BF13A1DBE	076.80.005	10/6/2002	510	500	1585	N	LNF
1BF168C389	076.80.004	10/6/2002	411	395	515	N	BFC
1BF1679221		10/6/2002	337	323	320	N	LNF
1BF16968A0		10/6/2002	334	318	325	N	BFC
1BF16948CA		10/6/2002	340	323	330	N	BFC
0000000000		10/6/2002	330	315	320	N	BFC
1BF146124F	076.80.008	10/7/2002	399	379	600	N	NFC
1BF146124F		10/7/2002	335	321	340	N	LNF
1BF1446E80		10/7/2002	340	325	350	N	BFC
1BF1446E80		10/7/2002	340	325	350	N	BFC
1BF1444FF3	076.80.020	10/8/2002	391	380	570	N	LNF
1BF145C48F	076.80.019	10/8/2002	390	377	640	N	LNF
1BF14BA339	076.80.012	10/8/2002	521	508	1275	N	LNF
1BF1447513	076.80.009	10/8/2002	525	507	1330	N	LNF
1BF14B83D2		10/8/2002	377	360	495	N	LNF
1BF145D2B8		10/8/2002	340	321	295	N	LNF
1BF14606C5		10/8/2002	275	264	155	N	BFC
1BF14606C5		10/8/2002	311	298	270	N	BFC
1BF145DDF7	076.80.046	10/18/2002	427	412	720	N	LNF
1BF14B807A	076.80.045	10/18/2002	465	459	1030	N	LNF
1BF1446BD0	076.80.044	10/18/2002	515	499	1420	N	LNF

Appendix A. Table 1, Continued.

PIT TAG Number	Frequency Code	Date	Total Length (mm)	Fork Length (mm)	Weight (g)	Recapture	Group
1BF1445292	076.80.043	10/18/2002	625	608	2330	N	LNF
1BF1447FBC	076.80.037	10/18/2002	470	458	750	N	LNF
1BF145DE29	076.80.031	10/18/2002	395	385	600	N	LNF
1BF14B8C95		10/18/2002	364	349	410	N	LNF
1BF1460275		10/18/2002	337	323	310	N	LNF
1BF145CEE7		10/18/2002	425	409	570	N	LNF
1BF1447138		10/18/2002	429	419	640	N	LNF
1BF145FB28	076.80.021	10/19/2002	463	449	760	N	NFC
1BF145FE7E		10/20/2002	325	311	280	N	NFC
1BF1421F6D	149.42.113	10/21/2002	458	440	920	Y	NFC
1BF146090F	076.80.039	10/21/2002	403	386	540	N	NFC
1BF14463B6	076.80.038	10/21/2002	467	455	1390	N	NFC
1BF145C1C9	076.80.035	10/21/2002	394	389	680	N	NFC
1BF1462559	076.80.034	10/21/2002	414	403	720	N	NFC
1BF1461006	076.80.033	10/21/2002	428	414	850	N	NFC
1BF144530C	076.80.032	10/21/2002	441	433	1100	N	NFC
1BF144530C	076.80.032	10/21/2002	441	433	1100	N	NFC
1BF14B8573		10/21/2002	362	349	440	N	NFC
1BF1445172		10/21/2002	377	364	490	N	NFC
1BF14B8B6A	076.80.049	10/22/2002	406	390	575	N	NFC
1BF14614E1	076.80.024	10/22/2002	419	409	880	N	NFC
1BF14628C1	076.80.023	10/22/2002	463	449	920	N	NFC
1BF14B8AED	076.80.022	10/22/2002	387	372	540	N	NFC
1BF144545B		10/22/2002	313	302	260	N	NFC
1BF146061A			233	218	115	N	LNF

Appendix A. Table 2. Radio-tagged bull trout distribution in the North Fork Clearwater River, 2001-2002.

Bull Trout Radio Number Frequency-Code	Tagging Subgroup	Watershed Group 2002	Date Past Fixed Site Upstream	Date located at Maximum Migration Point ²	Date Past Fixed Site Downstream	Migration Distance From Tagging Location (km) ¹ 2002
148.77.134	NFC	Cold Springs		19-Aug-02		88.64
148.77.135**	NFC	Cold Springs		6-Aug-02		71.40
149.42.116	NFC	Cold Springs	13-Jul-02	6-Aug-02		93.63
149.42.124	NFC	Cold Springs		19-Sep-02		84.04
149.42.117	NFC	Cold Springs Creek		6-Aug-02		94.43
148.77.138	LNF	Collins Creek		3-Sep-02	2-Oct-02	54.70
149.42.113	NFC	Collins Creek	13-Jul-02	19-Sep-02	27-Oct-02	29.30
149.42.123	NFC	Collins Creek		6-Aug-02		41.55
149.44.064	BFC	Headwaters NFCR	13-Jun-02	19-Sep-02		152.70
148.77.144	NFC	Headwaters NFCR		3-Sep-02		130.60
149.44.061	LNF	Kelly Creek		19-Sep-02	11-Oct-02	124.90
149.42.131	NFC	Kelly Creek	10-Jul-02	6-Aug-02		110.60
149.44.076	NFC	Kelly Creek		31-Oct-02		89.60
148.77.148	LNF	Long Creek		6-Aug-02		139.10
148.77.133	NFC	Long Creek		19-Aug-02		93.80
148.77.136	NFC	Long Creek	11-Jul-02	19-Aug-02		91.70
148.77.155	NFC	Long Creek		6-Aug-02		120.70
149.42.110	NFC	Long Creek		6-Aug-02		107.50
149.42.111	NFC	Long Creek		6-Aug-02		119.50
149.42.114	NFC	Long Creek		6-Aug-02		121.30
149.42.118	NFC	Long Creek		6-Aug-02		114.10
149.42.119	NFC	Long Creek		3-Sep-02		113.50
149.42.125	NFC	Long Creek		6-Aug-02		95.40
149.44.072	NFC	Long Creek		3-Sep-02		121.30
149.44.073**	NFC	Long Creek		6-Aug-02		103.80
149.42.115	NFC	Lost Pete Creek	12-Aug-02	3-Sep-02	18-Oct-02	30.81
149.42.120**	NFC	Lost Pete Creek		10-Jul-02		20.02
149.42.115	NFC	Lost Pete Creek	12-Aug-02	3-Sep-02	18-Oct-02	30.81
149.42.120**	NFC	Lost Pete Creek		10-Jul-02		20.02

Appendix A. Table 2, Continued.

Bull Trout Radio Number Frequency-Code	Tagging Subgroup	Watershed Group 2002	Date Past Fixed Site Upstream	Date located at Maximum Migration Point²	Date Past Fixed Site Downstream	Migration Distance From Tagging Location (km)¹ 2002
148.77.132	NFC	Osier Creek		19-Sep-02		115.00
148.77.154**	NFC	Osier Creek		6-Aug-02		110.90
149.42.122	NFC	Quartz Creek		3-Sep-02	13-Oct-02	26.38
149.42.085	BFC	Floodwood Creek		19-Aug-02		7.50
148.91.023	BFC	Middle LNF		10-Jul-02		-20.29
148.91.031	BFC	Middle LNF	19-Jul-02	6-Aug-02		5.39
149.42.065**	BFC	Middle LNF	18-Jun-02	30-May-02		-0.50
148.77.008	DWR	Middle LNF	16-Jul-02	22-Jul-02		50.55
148.77.150**	LNF	Middle LNF		21-May-02		0.00
148.91.018	LNF	Middle LNF	10-Jul-02	22-Jul-02		3.41
148.91.021	LNF	Middle LNF		22-Jul-02		5.48
148.91.027	LNF	Middle LNF		3-Sep-02		-3.25
149.44.069	BFC	Stony Creek	9-Aug-02	22-Jul-02	30-Sep-02	20.60
149.42.128	DWR	Stony Creek		6-Aug-02		19.73
149.44.067*	BFC	Upper LNF	22-Jun-02	3-Sep-02		64.86
149.42.088	DWR	Upper LNF	11-Jun-02	19-Sept.-02		48.78
148.77.137	LNF	Upper LNF	18-Jun-02	3-Sep-02		77.30
148.77.139	LNF	Upper LNF		6-Aug-02		61.10
148.77.140	LNF	Upper LNF	21-Jun-02	19-Sep-02	30-Sep-02	69.50
148.77.141	LNF	Upper LNF	11-Jun-02	3-Sep-02	12-Oct-02	64.00
148.77.142	LNF	Upper LNF	13-Jun-02	3-Sep-02	29-Sep-02	70.90
148.77.147	LNF	Upper LNF	22-Jun-02	3-Sep-02	21-Oct-02	62.90
148.77.151	LNF	Upper LNF	26-Jun-02	3-Sep-02	30-Sep-02	58.60
148.91.022	LNF	Upper LNF	24-Jun-02	6-Aug-02		67.07
148.93.013	LNF	Upper LNF		3-Sep-02		72.80
149.42.129	LNF	Upper LNF	18-Jun-02	6-Aug-02	28-Sep-02	34.98
149.44.063	LNF	Upper LNF	30-Jun-02	3-Sep-02	29-Sep-02	79.50
149.44.065	LNF	Upper LNF	11-Jun-02	19-Aug-02	18-Oct-02	33.80
149.44.075*	LNF	Upper LNF	10-Jun-02	3-Sep-02		72.70
148.93.035	BFC	Lower NFCR		6-Aug-02		-11.38
149.42.062	BFC	Lower NFCR	13-Jun-02	30-May-02		-6.91
149.42.127***	DWR	Lower NFCR		21-May-02		1.00
149.42.130	NFC	Lower NFCR		6-Aug-02		-15.50

Appendix A. Table 2, Continued.

Bull Trout Radio Number Frequency-Code	Tagging Subgroup	Watershed Group 2002	Date Past Fixed Site Upstream	Date located at Maximum Migration Point²	Date Past Fixed Site Downstream	Migration Distance From Tagging Location (km)¹ 2002
148.93.027	DWR	Middle Dworshak Reservoir		6-Aug-02		-34.04
148.93.015	DWR	NFCR		19-Sep-02		26.80
149.42.089	DWR	NFCR		21-Nov-02		32.90
148.77.145	NFC	NFCR		19-Aug-02		20.20
148.93.010	NFC	NFCR		10-Jul-02		15.10
149.42.112**	NFC	NFCR		10-Jul-02		10.80

¹ A negative number indicates that the bull trout moved downstream from its tagging location.

² Date located at maximum number migration is within 15 days of actual date due to flight schedule.

* Mortality or shed tag within riverine habitat. Tag recovered.

** Tag not collected but believed shed or mortality.

***Believed to be a tagging related mortality.

Appendix A. Table 3. Mean migration distances for each watershed group in the North Fork Clearwater River Drainage in 2002.

All Watershed Groups in the North Fork Clearwater River Drainage		Dworshak Reservoir Watershed Groups			
All Watershed Groups			Lower NFCR	Middle Dworshak Reservoir	NFCR
Mean	67.3	Mean	-8.2	-34.0	21.2
Standard Error	5.40	Standard Error	3.5	0.0	4.0
Median	69.5	Median	-9.1	-34.0	20.2
Standard Deviation	41.46	Standard Deviation	7.1		8.9
Sample Variance	1718.71	Sample Variance	49.9		78.7
Minimum	0	Minimum	-15.5	-34.0	10.8
Maximum	152.7	Maximum	1.0	-34.0	32.9
Sample Size	59	Sample Size	4	1	5

Mainstem North Fork Clearwater River Watershed Groups.								
	Cold Springs Creek	Collins Creek	Headwaters NFCR	Kelly Creek	Long Creek	Lost Pete Creek	Osier Creek	Quartz Creek
Mean	86.4	41.8	141.7	108.4	111.8	25.4	113.0	26.4
Standard Error	4.2	7.3	11.1	10.3	4.0	5.4	2.0	0.0
Median	88.6	41.5	141.7	110.6	113.8	25.4	113.0	26.4
Standard Deviation	9.4	12.7	15.6	17.8	14.0	7.6	2.9	
Sample Variance	88.1	161.4	244.2	315.3	195.6	58.2	8.4	
Minimum	71.4	29.3	130.6	89.6	91.7	20.0	110.9	26.4
Maximum	94.4	54.7	152.7	124.9	139.1	30.8	115.0	26.4
Sample Size	5	3	2	3	12	2	2	1

Mainstem Little North Fork Clearwater River watershed groups.				
	Floodwood Creek	Middle LNF	Stony Creek	Upper LNF
Mean	7.5	5.1	20.2	62.6
Standard Error	0.0	7.1	0.4	3.6
Median	7.5	1.7	20.2	64.9
Standard Deviation		20.1	0.6	13.8
Sample Variance		405.8	0.4	189.5
Minimum	7.5	-20.3	19.7	33.8
Maximum	7.5	50.6	20.6	79.5
Sample Size	1	8	2	15

Appendix A. Table 4. Redd survey locations and sizes for each drainage surveyed in 2002.

Stream	Survey Date	Redd Number	Size (cm ²)	Latitude	Longitude
Little North Fork Clearwater					
Butte Creek	9/10/2002	BTC-01	18600	47.02.344'	115.43.738'
	9/10/2002	BTC-02	5500	47.01.781'	115.45.398'
		Mean size	12050		
Little Lost Lake Creek	9/9/2002	LLLC-01	1575	47.05.289'	115.54.087'
	9/9/2002	LLLC-02	1400		
	9/9/2002	LLLC-03	1750		
	9/9/2002	LLLC-04	1375		
	9/9/2002	LLLC-05	1250	47.05.051'	115.54.902'
	9/9/2002	LLLC-06	1000	47.05.051'	115.54.909'
	9/9/2002	LLLC-07	2250	47.05.030'	115.54.998'
		Mean size	1514.3		
Lund Creek	9/9/2002	LND-01	6300	47.03.616'	115.53.590'
	9/9/2002	LND-02	13500	47.03.617'	115.53.607'
	9/9/2002	LND-03	20700	47.03.372'	115.54.095'
	9/25/2002	LND-04	2100	47.03.946'	115.53.136'
	9/25/2002	LND-05	2475	47.03.715'	115.53.310'
	9/25/2002	LND-06	3750	47.03.760'	115.53.252'
	9/25/2002	LND-07	4950	47.03.682'	115.53.381'
	9/25/2002	LND-08	4050	47.03.609'	115.53.556'
	9/25/2002	LND-09	4000	47.03.529'	115.53.853'
	9/25/2002	LND-10	3850	47.03.488'	115.53.942'
		Mean size	6567.5		
Rocky Run Creek	9/10/2002	RRC-01	12250	47.04.112'	115.49.143'
	9/10/2002	RRC-02	11700	47.02.802'	115.50.352'
	9/10/2002	RRC-03	18900	47.02.645'	115.50.505'
	9/10/2002	RRC-04	3150	47.02.497'	115.50.717'
	9/25/2002	RRC-05	5525	47.02.807'	115.50.388'
	9/25/2002	RRC-06	7000	47.02.504'	115.50.642'
		Mean size	9754.2		
Upper Little North Fork	9/25/2002	LNF-01	8500	47.04.403'	115.48.958'
	9/25/2002	LNF-02	8400	47.04.156'	115.49.047'
	9/25/2002	LNF-03	4800	47.04.021'	115.50.828'
	9/9/2002	LNF-04	9100	47.03.921'	115.51.017'
	9/9/2002	LNF-05	25000	47.03.984'	115.50.987'
	9/9/2002	LNF-06	21250	47.05.702'	115.53.896'
	9/9/2002	LNF-07	5775	47.05.737'	115.53.993'
	9/9/2002	LNF-08	5500	47.05.851'	115.54.175'

Appendix A. Table 4, Continued.

Stream	Survey Date	Redd Number	Size (cm ²)	Latitude	Longitude
Little North Fork Clearwater					
Upper Little North Fork	9/10/2002	BTC-01	18600	47.02.344'	115.43.738'
	9/9/2002	LNF-09	6900	47.05.892'	115.54.188'
	9/9/2002	LNF-10	19000	47.06.037'	115.54.273'
	9/9/2002	LNF-11	24150	47.06.048'	115.54.432'
	9/9/2002	LNF-12	7800	47.06.050'	115.54.435'
	9/9/2002	LNF-13	3400	47.06.064'	115.54.473'
	9/9/2002	LNF-14	4750	47.06.086'	115.54.585'
	9/9/2002	LNF-15	2100	47.06.096'	115.55.487'
Mean size			10428.33		